SCIENCE ABSTRACTS.

Section A.—PHYSICS.

JUNE, 1929.

GENERAL PHYSICS.

1739. Relationship between the Physical Constants of a Liquid. W. Perschke. *Zeits. f. Elektrochem.* 35. *pp.* 13–17, *Jan.*, 1929.

The relationship between a number of physical constants is examined. The constants considered are: density and temperature, surface tension and temperature, viscosity and temperature, heat of vaporisation and temperature, specific heat, index of refraction, velocity of sound and temperature, and also of the changes of each of these with each other. It was shown that a series of empirical logarithmic relationships of the form $\log X = a + b . \log . t$, can be developed, where t is the critical temperature. The equation was verified for the pairs of constants mentioned. F. J. B.

1740. Ellipsoidal Pendulum. D. Buchanan. *Roy. Soc. Canada, Trans.* 22. *Sect.* 3. *pp.* 193–209, *May*, 1928.

This paper, entirely of a mathematical character, deals with the motion of a particle on the smooth surface of an ellipsoid of revolution. A. A. D.

1741. Influence of the Mass of the Pen on the Dynamical Properties of Indicators. F. Dubois. *Zeits. f. Instrumentenk.* 48. *pp.* 585–597, *Dec.*, 1928.

The problem was first considered by O. Holm [see Abstract 1115 (1928)]. The present paper contains a criticism of Holm's mathematical treatment. A. A. D.

1742. Influence of the Mass of the Pen on the Dynamical Properties of Indicators. O. Holm. *Zeits. f. Instrumentenk.* 48. *pp.* 597–600, *Dec.*, 1928.

A reply to Dubois [see preceding Abstract, also Abstract 1115 (1928)]. Admits some of Dubois's criticism, but claims that even when these fresh considerations are taken into account the original results are not invalid. A. A. D.

1743. Shortt Clocks and the Earth's Rotation. J. Jackson. *Roy. Astron. Soc., M.N.* 89. *pp.* 239–250, *Jan.*, 1929.

The author analyses the observed clock errors of the Shortt clocks in the form of $\alpha + \beta t + \gamma t^2 + \delta \int (T - T_0) dt +$ nutation. [See Abstract 2025 (1928).] The coefficient β is the rate of the clock at zero epoch, γ is a measure of the change of rate, and δ, the temperature coefficient, is reduced by the makers nearly to zero, but for these clocks amounts to about $1^s \cdot 1$ per year per °F. A table is given of the comparison of clock errors observed with those predicted from March to December, 1927, and the residuals show oscillations of a kind which cannot be explained by slight adjustments of constants. The author gives attention especially to the term involving γ, and considers physical causes for its change. He rejects the growth of the invar rod, since this would not accord with the sudden changes of γ at times and its remaining constant for other long periods. He also rejects chemical changes such as the amalgamation of mercury with the type metal of the bob, and the effect of the earth's magnetic field on invar. He states that if the moon observations during 1928 give an irregularity greater than $1''$, corresponding to 2^s in the earth's rotation, such an irregularity is not due to an irregularity in the earth's rotation. A. S. D. M.

1744. Influence of the Inertia of the Spiral Spring on the Behaviour of a Chronometer. J. Haag. *Comptes Rendus*, 188. *pp.* 307–310, *Jan.* 21, 1929.

In a preceding note [*ibid.*, 186. pp. 1819–1821, June 25, 1928] it was shown that the influence of the spiral spring could be evaluated by means of the function $H = \int_0^1 \rho^2 s^2 ds$, where ρ is the distance of the centre of gravity of the arc s from the extremity, the origin being the peak. In this paper a complete practical solution of the problem is given in which it is shown that the terminal curves contribute a factor in the perturbations which cannot be neglected. The cases of the flat and cylindrical spiral are considered. H. H. Ho.

1745. Leaking Microbarograph used as a Variograph. S. Suzuki and H. Oomori. *Phys. Math. Soc. Japan, Proc.* 10. *pp.* 181–206, *Oct.*, 1928. *In English.*

The authors explain the causes of the discrepancies in the former expressions calculated for use with the instrument, and establishes that the record of the pressure variation begins to be disturbed by the natural vibration of the instrument when the period of the minor fluctuations of the barometric pressure becomes rapid and approaches the natural period. Otherwise, the statical treatment of the problem is sufficiently accurate. In the dynamical solution the dependence of the sensitivity on the thickness and density of the liquid is shown. Tests were carried out with two microbarographs arranged side by side, one being without a capillary tube, and the results are shown. It is proved that the leaking microbarograph is better for use as a variograph—the recorder of the time-rate of atmospheric pressure change—if Poiseuille's constant is adopted absolutely. The liquid in the floating basin sometimes plays an important part and cannot be neglected in the determination of the motion of the microbarograph. R. S. R.

1746. Nineteenth Exhibition of the Physical and Optical Societies. A. Ferguson. *Journ. Sci. Instruments*, 6. *pp.* 51–57, *Feb.*, 1929.

Notes on exhibits: Research and experimental section. A. D.

1747. Nineteenth Annual Exhibition of the Physical and Optical Societies. V. T. Saunders, E. G. Bilham, H. Hartridge and D. T. Harris. *Journ. Sci. Instruments*, 6. *pp.* 69–75, *Feb.*, 1929.

Notes on exhibits: Educational apparatus and experiments; meteorological instruments; physiological apparatus. A. D.

1748. Variation with Direction of the Capillary Constant of Smectic Bodies. R. Gibrat. *Comptes Rendus*, 188. *pp.* 183–185, *Jan.* 7, 1929.

The observation of very elongated distortion from the spherical shape for drops of smectic substances conforms to the existence of two minima for the capillary constant, and the author now deduces an algebraic expression based on a general hypothesis of molecular distribution which gives these minima. H. H. Ho.

1749. Measurement of Surface Tension by the Disc Method. J. E. Verschaffelt. *Ann. Soc. Sci. de Bruxelles*, 48. *pp.* 90–92, *Dec.*, 1928.

The method consists in measuring, by means of a balance, the maximum force required to detach a horizontal disc from the surface of a liquid. The maximum force is $\pi r^2 g d a \sqrt{2} . f(r/a)$, where r is the radius of the disc, d is the difference in density between the liquid and the surrounding gas, a is the capillary constant $\sqrt{2\sigma/dg}$, and σ is the surface tension. The function $f(r/a)$ is expressed for extreme values of r/a, and is determined by experiment for a number of liquids, using discs of different sizes. It is found that as r/a varies from $0 \cdot 1$ to $1 \cdot 0$, $f(r/a)$ varies from $1 \cdot 028$ to $1 \cdot 824$. G. E. A.

1750. Influence of Surface Tension on Viscosity Measurements. S. Erk. *Zeits. f. phys. Chem.* 140. *Abt. A.* 3–4. *pp.* 309–315, *Feb.*, 1929.

The influence of surface tension on viscosity measurements by the capillary method is discussed. The experimental work of Traube and Whang [see Abstract 662 (1929)] is referred to and it is theoretically deduced and experimentally confirmed that their deductions are incorrect because they neglected to consider this surface-tension effect. J. K.

1751. Physical Basis of Lubrication Phenomena, Particularly in Internal-Combustion Engines. S. Kyropoulos. *Zeits. f. techn. Physik*, 10. 1. *pp.* 2–18, 1929.

The physical properties, particularly viscosity and capillarity, as well as the dielectric constant and electrical conductivity of a large number of oils were investigated as to dependence on temperature. The results are tabulated and discussed. From the viscosity and temperature measurements made the optimum viscosity for a particular motor could be found. The optimum lies in the direction of lower viscosity. A. W.

1752. Influence of Surface Conditions on the Friction of Metals. R. B. Dow. *Phys. Rev.* 33. *pp.* 252–257, *Feb.*, 1929.

The present investigation, by an improved tilt method, attempts accurately to determine the static coefficient of friction for metallic surfaces under varying surface conditions in different media. The presence and nature of oxide films materially affect the rise of the friction curve; a thin film acting as an abrasive causes the curve to rise, the rate depending on the normal force, until a layer of increased stability is reached. In terms of surface flow this indicates the formation of a vitreous layer. Thick films of certain oxides act as lubricants of great stability. Area of rubbing, shape of surfaces and dry gases have no influence on μ; moist inert gases show a capillary effect, moist active gases destroy the surfaces. μ is found to be a linear function of the number of slips of one surface over another. AUTHOR.

1753. New Theory of Elastic Restraints and its Technical Applications. G. Colonnetti. *Accad. Lincei, Atti*, 7. *pp.* 817–821, *May* 20, 1928.

Given a reticulated framework—a system of material points or *nodes* joined together by *rods* (prismatic, perfectly elastic, and hinged together) in number superior to that strictly required to define the relative positions of the single nodes—and let it be supposed possible to alter at will the lengths of the separate rods. The forces of tension and compression, which in the single rods can, along with the external forces, maintain equilibrium, are considered. The analysis shows that the force in any rod of the arrangement, produced by a system of impressed variations Δ, may be obtained by assuming that there is impressed on the rod itself an arbitrary variation of length Δ'_K and adding together the forces so generated in the various rods of the framework, multiplied respectively by the corresponding impressed variations Δ referred to Δ'_K as the unit of measurement.

The force produced in any rod whatever of the framework by a given variation of length impressed on another rod is equal to the force that in this second rod is produced by impressing the same variation of length on the first (Principle of Reciprocity).

The diagram of the forces that are produced in the different rods of a framework may be found by supposing impressed on a definite rod a variation of length Δ'_K, whence follow the forces that in this last rod are determined by impressing equal variations of length on all the other remaining rods. J. J. S.

1754. Mathematical Discussion on the Structure of Wood in Relation to its Elastic Properties. A. T. Price. *Roy. Soc., Phil. Trans.* 228. *pp.* 1–62, *Dec.* 11, 1928.

Wood, from its structure, is definitely anisotropic as regards its elastic properties, and a knowledge of the nature of the dependence of this anisotropy upon its structure would seem desirable to improve methods of testing, and to enable more correct estimates of the strength of wooden members to be obtained. St. Venant's "rari-constant" theory is not borne out by experiment, but structure suggests the existence of three perpendicular planes of symmetry, longitudinal, radial and transversal, but again experiment does not agree with the theory appropriate to a homogeneous, aelotropic solid. Cell structure suggests an examination of a material consisting of thin-walled cylinders of isotropic material, with their axes parallel, and joined along generators. This model shows greater anisotropy than wood, but this is explained by the fact that the cells are often more nearly hexagonal or rectangular than cylindrical, and are not open, but taper or are closed in some way. Again, the annual layers may introduce a modification, and a full study of the stress system in beams and plates composed of two different layers cemented together is undertaken. It appears that the apparent Young's moduli for stretching and bending are not equal, but the width of the beam only affects their ratio slightly, even for a steel-lead combination. Difference of Poisson's ratio produces lateral stresses. Finally, the case of a material which is heterogeneous (in layers) and anisotropic is considered. The apparent Young's modulus is now the same for stretching as for bending parallel to or perpendicular to the annual layers, except for small periodic terms depending upon the number of layers, and decreasing as that number increases. Experimental evidence as to some dependence upon the direction of bending must be attributed to the effect of medullary rays. The calculated effect of the layers upon the apparent Young's moduli in the radial and tangential directions is, however, opposite to that found experimentally; presumably it is overshadowed by the effects of the medullary rays. Application is also made to ply-wood, and the apparent Young's modulus for bending differs greatly in two perpendicular directions—but this is almost entirely due to the difference of Young's modulus for the layers, and only slightly to the difference in Poisson's ratio. The lateral stresses due to the latter cause are also very small. Similar treatment of the moduli of rigidity for cellular and stratified material gives similar results. Experiment, however, gives discrepant results according as the moduli are calculated from torsion or oblique compression tests. There is also a time effect. This points to slip parallel to the grain, and microscopic examination bears this out. Thus wood cannot be considered as an elastic material for shearing stress. W. G. B.

1755. Simultaneous Measurement of Plasticity and Elasticity. E. C. Bingham and J. W. Robertson. *Kolloid Zeits.* 47. *pp.* 1–5, *Jan.*, 1929.

The method proposed depends on the alternating pressure which the material investigated will exert on both ends of a capillary when the latter is oscillating. Visible particles are added to the fluid, and their movements under the varying pressure observed. A very suitable substance for investigation proved to be a 43 % solution of ammonium oleate. One of the difficulties surmounted was the construction of a valve by means of which the pressure could be recorded several hundred times per minute. Curves and data are included, although the method is not yet claimed to be out of the experimental stage. H. H. Ho.

1756. Plastic Properties of Jellies, their Temperature Dependence, and Preparation of Gelatinous Lenses. M. Kröger and K. Fischer. *Kolloid Zeits.* 47. *pp.* 14–19, *Jan.*, 1929.

A method for measuring the plastic properties of jellies is described by means of which a number of gels have been carefully studied. The temperature dependence of the plasticity showed that with decreasing temperature a deterioration in this property was established which is similar to other changes consequent on keeping. A method for the preparation of gelatinous lenses is also described. H. H. Ho.

1757. Motion of a Body of Variable Mass. T. Levi-Civita. *Accad. Lincei, Atti,* 8. *pp.* 329–333, *Nov.* 11, 1928.

Instead of the classical equation $m dv/dt = F$, the author shows that the equation $d(mv)/dt = F$, embodying the theorem of the quantity of motion, remains valid in restricted relativity. He takes into account those changes of mass which occur by the emission or absorption of radiation. E. E. F. d'A.

1758. Principles of a General Theory of Impact. Z. Horak. *Comptes Rendus,* 188. *pp.* 226–228, *Jan.* 14, 1929.

Mathematical. Equations are obtained for a nonholonomic system with n degrees of freedom, in tensor form. W. G. B.

1759. General Property of the Motion of a System of Material Points. J. le Roux. *Comptes Rendus,* 188. *pp.* 228–230, *Jan.* 14, 1929.

The reference system for which the kinetic energy of the relative motion is a minimum is found. It is one for which the total resultant momentum and the moments of momentum vanish. The forces acting form a system in equilibrium, and can be represented as a set of actions and reactions. W. G. B.

1760. Two Energy Types in Wave Motion and Their Relation to Group and Wave Velocity. L. Tonks. *Phys. Rev.* 33. *pp.* 239–242, *Feb.*, 1929.

The energy of an element in a wave motion can be of two kinds: first, non-interactive, like the energy of a set of independent pendulum bobs, and second, interactive, like the potential energy of an element of a stretched string which is dependent only on the relative position of the neighbouring elements. In the former case the group velocity is zero, and in the latter it equals the wave velocity. The slowing down of energy transmission in intermediate cases is discussed qualitatively and the ratio of group to wave velocity is calculated quantitatively in a number of cases on the assumption that the energy propagation is given not only by the product of energy density and group velocity, but also by the product of twice the interactive energy density and wave velocity. A general relation is suggested without proof for the connection between energy types and the ratio of group to wave velocity. The same ideas are applied to de Broglie's phase waves, the group velocity of which is the particle velocity. AUTHOR.

1761. Experiment in Statics. O. Gottschalk. *Frank. Inst., J.* 207. *pp.* 245–260, *Feb.*, 1929.

Previous work [see Abstract 2752 (1926)] on the solution of statical problems by visible simple experiments in place of the numberless equations and formulæ of mathematical statics is continued. Previously (*loc. cit.*) the "Continostat" was described and this is now applied to oblique and compound structures. § 1 deals with common structures; § 2 considers devices for irregular structures; § 3 is devoted to plastic models; § 4 investigates steel spline models; § 5 examines arches; and § 6 latticed trusses; finally, § 7 is concerned with compound structures, since the new methods have made it possible to calculate many statical problems which formerly had to be solved by empirical formulæ. The paper is illustrated by thirteen very informative diagrams. H. H. Ho.

1762. Connection between the Absence of Negative Pressures and the Sense of the Concavity of the Free Stream-Lines in the Plane Motion of an Incompressible Fluid round an Obstacle. J. K. de Fériet. *Comptes Rendus,* 188. *pp.* 230–232, *Jan.* 14, 1929.

Deduces the result from an analytical theorem. W. G. B.

1763. Transverse Circulation in Streams. H. Jeffreys. *Cambridge Phil. Soc., Proc.* 25. *pp.* 20–25, *Jan.*, 1929.

In the ordinary flow of a stream a slow transverse flow outwards from the middle near the bottom, and inwards near the top, is required to explain the fact that the filament of maximum onward velocity is depressed some distance below the centre of the free surface. Any satisfactory explanation must show uniform linear flow to be impossible, and various equations are shown to be invalid due to limitations in the hypothesis that the eddy-stress is a function of the tensor e_{ij}. The treatment of the eddy-viscosity as a strict analogue of ordinary viscosity is shown to be open to theoretical and experimental objections, and, whilst Taylor's modification somewhat mitigates the former, it does not appear to be a particular case of any law that can hold in three-dimensional motion. H. H. Ho.

1764. Action of a Viscous Fluid upon an Obstacle; Simple Demonstration of Faxén's Formulæ. J. Pérès. *Comptes Rendus*, 188. *pp.* 310–312, *Jan*, 21, 1929.

This is a mathematical investigation, the fluid being one in which the motion, slow and permanent, follows Stokes's equations, $\Delta U_j - \partial P/\partial x_j = 0$, $\partial U_j/\partial x_j = 0$ $(j = 1, 2, 3)$, U_j being components of the velocity, P the mean pressure, and the coefficient of viscosity being taken as unity. On introducing in the fluid a fixed solid, limited by the surface S, a new permanent motion is set up, with velocities $U_j + u_j$, pressure $P + p$, the terms u_j being integrals of the equations first given. The resultants of the actions of the fluid on S are calculated, and are expressed in terms of U_j. As an example, S is a sphere of radius a, which is the case treated by Faxén [see Abstract 2369 (1922)], obtained, however, less simply because the complicated expressions for u_j are made to intervene explicitly, determined either by series (Faxén), or by Green's functions [Oseen, *Hydrodynamic*, *Ak. Verlags.*, Leipzig, 1927, p. 106]. T. B.

1765. Motion of a Cylinder in a Viscous Fluid. A. Gay. *Comptes Rendus*, 188. *pp.* 375–377, *Jan.* 28, 1929.

Applies the results of a previous paper [see Abstract 1413 (1929)] to the circular cylinder, and shows that the integral equations can be solved by series which are absolutely and uniformly convergent. W. G. B.

1766. Energy Exchange of Divergent Streams. H. Lorenz. *Phys. Zeits.* 30. *pp.* 77–80, *Feb.* 1, 1929.

A mathematical discussion in which the conditions governing the formation of turbulent layers in divergent streams are considered. F. S.

1767. Continuous Irrotational Motion in Two Dimensions of an Undefined Liquid in Presence of a Fixed Cylindrical Obstacle. N. Neronoff. *Comptes Rendus*, 188. *pp.* 544–546, *Feb.* 18, 1929.

At infinity the speed of a perfect and incompressible liquid is constant in value and direction. If two points be taken on the contour of the obstacle where the speed is zero, they belong to a stream line, and the liquid motion is investigated on each side of this line. A general expression for the motion is derived from which special real cases are discussed, including those of the circular and elliptical cylinder. H. H. Ho.

1768. Method of Measuring Fluid Velocity with Oscillator Valves. P. Dupin. *Comptes Rendus*, 188. *pp.* 546–548, *Feb.* 18, 1929.

The author describes an apparatus whereby the speed of a liquid may be measured instantaneously by direct reading on a graduated scale. The principle utilised is the modification of wave-length of an oscillating circuit produced either by a variation of capacity or by a variation of the self-induction of the circuit under the influence of the liquid velocity. Apparatus details are included. H. H. Ho.

1769. Hexagonal Silver Iodide. N. H. Kolkmeijer, W. J. D. van Dobbenburgh and H. A. Boekenoogen. *K. Akad. Amsterdam, Proc.* 31. 10. *pp.* 1014–1027, 1928.

From measurements made on X-ray powder and other photographs it is concluded that the density of hexagonal silver iodide is 5·681 and the axial ratio $c/a = 1 \cdot 633$. The difficulty of determining the purity of a substance by means of powder photographs is discussed. W. H. Ge.

1770. Crystalline Structure of Solid Mercury. M. Wolf. *Zeits. f. Physik*, 53. 1–2. *pp.* 72–79, 1929.

Describes a "thermostat" X-ray spectrograph, in which the specimen is mounted in a hollow in a copper block, which forms the lower end of what is practically a metal Dewar vessel built into the instrument, the two vacuums communicating. Some difficulty was experienced in obtaining solid mercury in the form of powder. An emulsion of mercury was prepared in a solution of gelatine in water, but the particles remained liquid at − 80° C., and the spectrogram showed mainly the fluid band of mercury, and hardly any lines due to solid particles. The difficulty was got over by hammering a mass of frozen mercury, or rubbing it with emery paper, so as to get a fine powder. The results obtained agree with those of MacKeehan and Cioffi. The structure is represented by a face-centred rhombohedron with edges 4·598 Å., the angle between the rhombohedral axes is 98° 14′. This rhombohedron is obtained from a face-centred cube by shortening by 15·47 % in a diagonal direction. For the density of mercury at about − 80° C. the value 14·12 was obtained. H. N. A.

1771. Structure of Nickel. L. Mazza and A. G. Nasini. *Phil. Mag.* 7. *pp.* 301–311, *Feb.*, 1929.

An X-ray examination of samples of nickel obtained by electrolytic deposition by separation from $Ni(CO)_4$ and by reduction of the oxide showed them to be face-centred cubic $a = 3 \cdot 514 \pm 0 \cdot 002$ Å. The particle size ranged from 1×10^{-2} to 1×10^{-5} cm. The face-centred cubic form was always obtained when pure cold-drawn nickel was subject to various thermal treatments. Pure cold-drawn nickel subsequently annealed for a long time does not show recrystallisation structures detectable by X-ray analysis for annealing temperatures up to 940° C. Characteristic recrystallization only appears at 1000° C. and upwards. Prolonged annealing (30 hrs.) at 1200° C. gave a recrystallisation in coarse grains, irregularly oriented. Quenching produced no change in the lattice dimensions. W. H. Ge.

1772. Fusibility of the Elements and the Electron Number. P. Vinassa. *Accad. Lincei, Atti*, 8. *pp.* 121–125, *Aug.*, 1928.

The fusibility of a body is more simply related to its electronic number than to its atomic number or atomic volume, since it depends mainly upon its peripheral electrons. The ratio of the fusing point to the electronic number is called the coefficient of fusion. This coefficient varies according to a periodic law, but is always an exact multiple of 0·5, which is the value of the coefficient for helium. The author gives a table of the elements with their calculated and observed fusing points, and traces some striking peculiarities. E. E. F. d'A.

1773. Allotropic Varieties of Phosphorus and the Theory of Smits. P. Jolibois. *Comptes Rendus*, 188. *pp.* 174–176, *Jan.* 7, 1929.

Critique of Smits, referring to the author's researches of 1910. He agrees with Smits as to the measurement of the vapour tension only of liquid phosphorus. With solid phosphorus equilibrium is very slowly attained, unless the phosphorus is powdered and all gas withdrawn. Ordinary red phosphorus, powdered, keeps its density 2·16 when heated to 360° for 100 hours. In the presence of 1 % of iodine the density of the pyromorphic phosphorus is 2·37 (after removal of the iodide formed), and there is no solid solution in equilibrium. The equilibria assumed by Smits are the false equilibria of Duhem to which the laws of thermodynamics are not applicable. There are four varieties of solid phosphorus, white, red, black and pyromorphic, which may co-exist at ordinary temperature. Only the pyromorphic, and possibly the black, are stable; the other varieties represent slowly-changing intermediate stages. H. B.

1774. Allotropic Modification of Phosphorus. A. Smits. *Comptes Rendus*, 188. *pp*. 390–392, *Jan*. 28, 1929.

A further vapour pressure-density graph of phosphorus is given, which is more complete than that in a recent paper [see Abstract 1433 (1929)] and has three horizontal lines, which would agree fairly with that of Nicolaiev, if there were only three modifications, white, purple, violet, not black. Another graph is also shown which would satisfy a stable violet modification, but not the black which is metastable at ordinary temperature. H. B.

1775. Free and Bound Electrons in Metals. R. Ruedy. *Phys. Rev*. 32. *pp*. 974–978, *Dec*., 1928.

In metals the dependence of the conductivity upon the number of outer electrons in the atoms is well marked. It may be assumed that the number of free electrons is about equal to the number of valency electrons. The electrical conductivity of the metal is closely connected with its optical properties. Thus, the reflective power in the far infra-red region may be calculated from the specific conductivity of the metal. The better the conductivity the stronger is the absorption. Down to wave-lengths larger than about 4 μ the metals behave optically as if they contained only free electrons. But in the visible spectrum signs of bound electrons set in vibration by the incident light waves appear. The relative number of free and bound electrons may be investigated by a study of the optical properties of the metal in the visible and ultra-violet spectrum. The author examines the results of some new measurements published in recent years from the point of view of the theory of dispersion and absorption, and from this theoretical investigation reaches the conclusion that the more recent values obtained for the absorption and dispersion of light by metals confirm the older ones and indicate the existence of bound electrons inside the metal comparable in number with that of the free electrons. J. J. S.

1776. Molecular Structure in Solution. Part IV. The Densities, Viscosities and Electrical Conductivities of Aqueous Solutions of Cobalt Chloride and Hydrochloric Acid at Different Temperatures. O. R. Howell. *Chem. Soc., J. pp*. 162–172, *Jan*., 1929.

The densities, viscosities and electrical conductivities of two aqueous solutions, one containing 120 gm. of $CoCl_2,6H_2O$ per litre with hydrochloric acid (4*N*) and the other hydrochloric acid (4*N*) alone, are determined at intervals of 5° from 0 to 80° and plotted against the temperature. The curves of each of the properties are smooth for both the solutions, and expressions have been found for them which give good agreement with the observed values. The three curves of differences are also smooth, unlike those obtained on continued addition of hydrochloric acid to cobalt chloride solution at constant temperature. It is therefore concluded that the relative number of oppositely charged cobalt ions in the solution is unchanged over the whole range of temperature and, therefore, during the colour change. Since the colour is determined by the number of groups surrounding the cobalt atom, it follows that the change must be due to addition and subtraction of water molecules, leaving the charge of the ion unaltered. The change may be represented by the expression:—

$$\xrightarrow{\text{HEATING}}$$

$$\text{RED}\left\{\begin{array}{l} Co(H_2O)_6^{\cdot\cdot} \rightleftarrows Co(H_2O)_4^{\cdot\cdot} \\ CoCl_4(H_2O)_2'' \rightleftarrows CoCl_4'' \end{array}\right\}\text{BLUE}$$

$$\xleftarrow[\text{COOLING}]{}$$

[See also Abstract 31 (1928).] J. N. P.

1777. Working Sectional Area and Molecular Structure in the Pseudo Rare Gas Series Ne, HF, H_2O, NH_3, CH_4. E. Brüche. *Ann. d. Physik*, 1. 1. *pp.* 93–134, *Jan.* 2, 1929.

Gives details of the experimental difficulties involved in the measurements of the working section in the case of vapours, including NH_3. The paper also contains accounts of the results obtained, and the conclusions drawn from them, which, however, are also contained in another recent paper by the author [see Abstract 1055 (1929)]. H. N. A.

1778. Formation of Atomic from Molecular Hydrogen by Collisions with Slow Electrons. K. E. Dorsch and H. Kallmann. *Zeits. f. Physik*, 53. 1–2. *pp.* 80–91, 1929.

The different ways in which primary and secondary formation of atomic hydrogen from hydrogen molecules may take place are considered in relation to the band spectrum of hydrogen. It is shown that primary formation of atoms by excitation of hydrogen molecules takes place above 10·8 volts, and a further increase begins above 14·5 volts. Secondary formation takes place when the collision with an electron produces a hydrogen molecular ion H_2^+, and this reacts chemically with a hydrogen molecule, forming an H_3^+ ion and a hydrogen atom. The authors have investigated the matter experimentally, using lead chloride as an indicator of the presence of atomic hydrogen, which reduces it to metallic lead and blackens it. A special apparatus was designed to show the above secondary formation of atoms; atoms formed by primary processes were filtered out of the hydrogen stream before it reached the plate covered with lead chloride, while the H_2^+ ions could be directed into the part of the tube near this plate, so that the atoms formed by them could reach the lead chloride. Other reactions which could blacken the PbCl were considered and avoided. H. N. A.

1779. Structure of the Multiplet S-States in Molecules with two Atoms. Parts I and II. H. A. Kramers. *Zeits. f. Physik*, 53. 5–6. *pp.* 422–438, 1929.

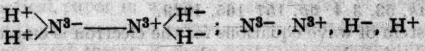
Deals with the peculiar splitting which Mulliken has observed for the rotational levels of the ^3S normal state of O_2, in connection with the atmospheric oxygen bands. These are due to passages from the ^3S state to an excited ^1S state. To explain the way in which the splitting takes place it is necessary to take into account the reciprocal action of the electronic magnets, and three kinds of terms have, in accordance with Heisenberg, to be introduced into the energy function, Ω_a which relates to the reciprocal action between the spin of an electron and the orbit of this electron, Ω_b between the spin and the orbits of the other electrons, Ω_c between the spin and the spins of the other electrons. In most atomic problems $\Omega_a + \Omega_b$ are much more important than Ω_c, but Heisenberg has showed that in the case of low atomic numbers the two quantities are of the same order of magnitude, and the anomalies in the splitting of the triplets of HI and LII can be explained as due to Ω_c. In the case of a diatomic molecule in the S-state $\Omega_a + \Omega_b$ to the first approximation give no splitting, while Ω_c gives splitting of the type found by Mulliken. The theory is worked out and diagrams are given showing the theoretical and observed splittings; certain differences between them are pointed out, and are explained qualitatively as due to the splitting caused by the magnetism of the rotating molecule. In Part II the theory is further developed, and it is shown that the influence of the electron spin in a diatomic molecule in the S-state is equivalent to a reciprocal action between the axis of the molecule and the resultant spin vector. In conclusion, the reciprocal action of the rotation of the molecule and the electron spin, first discussed by Hund, is investigated. H. N. A.

1780. Magnetic Moment of the Lithium Atom. D. A. Jackson. *Zeits. f. Physik*, 53. 5–6. *p*. 458, 1929.

Taylor [see Abstract 1438 (1929)] has remarked that the lithium atom must possess a nuclear magnetic moment less than one-third of a Bohr magneton, and this result is criticised adversely by the present author on spectral grounds. Reference is made to a previous paper [see Abstract 837 (1929)] in which the ratio of the magnetic moment of the cæsium nucleus to the moment of the electron is about 1 : 2000. H. H. Ho.

1781. Unpolar Combination and Atomic Refraction. Part II. R. Samuel. *Zeits. f. Physik*, 53. 5–6. *pp*. 380–403, 1929.

Applies the ideas of Part I [see Abstract 2263 (1928)] to a large number of organic compounds, assuming that individual organic radicles have two different refraction equivalents, the first when one of them acts as the more positive partner in a molecule, and the other when it acts as the more negative partner. A number of anomalies found in the observed molecular refractions are greatly reduced on the new theory, as is seen in a number of tables in the paper. It is also assumed that nitrogen can act as the more positive partner in some compounds, and as the more negative partner in others. The structure of hydrazine is represented as



$$\begin{matrix}H^+\\H^+\end{matrix}\!>N^{3-}\text{———}N^{3+}\!<\!\begin{matrix}H^-\\H^-\end{matrix}\ ;\quad N^{3-},\ N^{3+},\ H^-,\ H^+$$

do not represent ions, but more positive or more negative partners in an unpolar compound. The fact that an organic radicle is capable of combining in two different ways is illustrated in the so-called Grignard salts. Sulphur can be added to these, so that a molecule $R^- - Mg^{2+}$

$— I^- $ is converted into $R^+ — S^- — Mg^{2+} — I^-$. There can be no doubt that the metal Mg acts positively in both cases. H. N. A.

1782. Atomic Weight of Copper from the Lake Superior Region and from Chile. T. W. Richards and A. W. Phillips. *Am. Chem. Soc., J.* 51. *pp.* 400–410, *Feb.*, 1929.

There is reason to believe that the Lake Superior copper came from a deposit formed not later than the Cambrian, while that from Chile came from a series of lodes in granitic rock, intrusive in Jurassic strata. It was thought possible that the isotopic constitution might be different in the two cases, and in addition the atomic weight of copper needed confirmation. The copper in the samples was determined electrolytically, and the chlorine in a solution of recrystallised hydrated cupric chloride by precipitation with pure silver nitrate. Details of the methods employed are described, including a correction for crystals of atacamite, which precipitated from the solutions in small quantities. The atomic weight found for both kinds of copper was 63·557. H. N. A.

1783. Heats of Linkage of C-H and N-H Bonds from Vibration Spectra. J. W. Ellis. *Phys. Rev.* 33. *pp.* 27–36, *Jan.*, 1929.

The visible and near infra-red absorption data for several representative molecules are taken from a previous paper and fitted to the formula of an anharmonic vibrator, $\nu^n = \omega^0 n - bn^2$. The mechanical frequencies, $\omega^n = \omega^0 - 2bn$, are evaluated and plotted. Assuming that these frequencies originate in oscillations between a hydrogen atom and the remainder of the molecule, the restoring force residing in the C-H and N-H bonds, the heats of linkage of these bonds are calculated. The method originated by Birge and Sponer for the determination of the heats of dissociation of non-polar, diatomic, gaseous molecules is used. The heats of linkage for a hexane C-H bond is calculated to be 97,000 cal/mol in fair agreement with the 92,500 cal/mol value obtained thermochemically for its homologue, methane. The values for the heat of linkage vary among the different types of molecules, having the relatively high value of 117,000 cal/mol for benzene C-H bonds. The value for the N-H heat of linkage of aniline is calculated as 113,000 cal/mol, and is believed to agree with the 101,000 cal/mol obtained thermochemically for an ammonia N-H bond within the limits of determination of the former value. A possible explanation of the doubleness of the absorption bands observed in the spectra of several substances, notably hexane and cyclohexane, is sought in two types of carbon valence. This doubleness indicates a slight inequivalence in the energy content of two types of C-H bond. AUTHOR.

1784. Reflection of Electrons at a Potential Discontinuity According to the Relativistic Dynamics of Dirac. O. Klein. *Zeits. f. Physik*, 53. 3–4. *pp.* 157–165, 1929.

Dirac's system of wave equations for the electron is employed, and the solution sought for the case of an electron impinging on the boundary between two regions of constant electrostatic potentials V and zero respectively. It is shown that for high values of the potential discontinuity the theory leads to a state of affairs in which electrons pass through the discontinuity and emerge on the other side with a negative kinetic energy.

This result is an example of the serious difficulty involved in relativistic quantum dynamics. W. S. S.

1785. Spectroscopic Confirmation of the Quantum Mechanics Theory of Homöopolar Combination. W. Heitler and G. Herzberg. *Zeits. f. Physik*, 53. 1–2. *pp.* 52–56, 1929.

Evidence from band spectra is brought forward to show that certain atoms, such as the carbon atom, on being excited are capable of entering into a combination of higher valency. Such an effect is required by the quantum mechanical theory of homöopolar chemical combination. Example: the carbon atom in its ground state is to be regarded as divalent, the normal quadrivalency being obtained when the atom is excited by an amount equal to 1·6 volts (^{5}S-state). W. S. S.

1786. Einstein Formula and Brunonian Movements. V. Pospišil. *Phys. Zeits.* 30. *pp.* 82–83, *Feb.* 1, 1929.

A short method given for the deduction of Einstein's Brunonian movement formula from his fundamental equations and the principle of superposition. A. D.

1787. Symmetry of Protonic Wave Functions. B. Cassen. *Nat. Acad. Sci., Proc.* 15. *pp.* 29–31, *Jan.*, 1929.

The symmetry of the complete wave function of the H_2 molecule, and of the protonic and electronic wave functions into which it can be separated, is discussed, and the general conclusion is drawn that protonic wave functions are symmetric, from which it follows that protons will satisfy the Einstein-Bose statistics. W. S. S.

1788. One-Dimensional Relativity Kepler-Problem in Wave Mechanics. V. S. Vrkljan. *Zeits. f. Physik*, 54. 1–2. *pp.* 133–136, 1929.

It is now shown that whilst the three-dimensional relativity Kepler-Problem in wave mechanics does not lead to the correct formula for fine structure, the one-dimensional problem gives the same energy levels as are obtained on the Bohr-Sommerfeld theory. H. H. Ho.

1789. Quantum Mechanics of an Electron or Other Particle. E. H. Kennard. *Frank. Inst. J.* 207. *pp.* 47–78, *Jan.*, 1929.

The writer gives an account in simple terms of the changes in physical conceptions resulting from recent advances in quantum theory, and indicates how the principal phenomena have been handled in the new quantum mechanics. Heisenberg's Indetermination Principle is discussed very fully. W. S. S.

1790. Differential Geometry of Hermitian Differential Form and its Relation to the Field Equations of Physics. J. A. Schouten and D. van Dantzig. *K. Akad. Amsterdam, Proc.* 32. 1. *pp.* 60–64, 1928. *In German.*

A mathematical paper in which the significance of Hermite's fundamental tensors, the Riemannian metric and distance transfer are discussed. Einstein's recent field theory is more naturally derived from the theory developed. J. S. G. T.

1791. Basic Principles of Einstein's Special Theory of Relativity. M. Broszko. *Zeits. f. Physik*, 53. 1–2. *pp.* 151–153, 1929.

The principle of the constancy of the velocity of propagation of a light wave is shown to follow from the principle of relativity. This constancy of velocity of propagation of a wave motion relative to an inertial system is common to all phenomena exhibiting a space-time periodicity.

J. S. G. T.

1792. Differential Invariants in Einstein's Theory of Distant Parallelism. R. Weitzenböck. *Preuss. Akad. Wiss. Berlin, Ber.* 26. *pp.* 466–474, 1928.

The theory of differential invariants entering into Einstein's theory of distant parallelism is developed. These invariants being conceived as action functions, the consequent field equations are deduced. Further assumptions which can serve as a basis for the development of a field theory are briefly discussed. J. S. G. T.

1793. Continuous Probability Sequences. H. Reichenbach. *Zeits. f. Physik*, 53. 3–4. *pp.* 274–307, 1929.

A theory of causality and probability, distinguishing one from the other, is developed mathematically. J. S. G. T.

1794. Conference on the Michelson-Morley Experiment. *Mt. Wilson Observat. Contrib. No.* 373. *Astrophys. J.* 68. *pp.* 341–389; *Disc.*, 389–402, *Jan.*, 1929.

A general discussion of methods employed and results obtained from the Michelson-Morley experiment as performed by various experimenters. Contributions are made by Michelson, Lorentz, Miller, Kennedy, Hedrick, Epstein and Bateman. J. S. G. T.

1795. New Experiment relating to Ether Drift. A. Piccard and E. Stahel. *Zeits. f. Physik*, 53. 3–4. *p.* 312, 1929.

The authors point out that the experiment proposed by Dworsky for determining ether drift [see Abstract 720 (1929)] must have a negative result, as it is not possible to direct a ray in an absolutely definite direction.

J. S. G. T.

METEOROLOGY AND GEOPHYSICS.

1796. Weather Analysis Associated in Three Dimensions. Part I. Main Introduction to the Problem of Air Masses and Front Formation. T. Bergeron. *Geofysiske Publ. Oslo*, 5. 6. [111 *pp.*], 1928. *In German.*

After a review of the development of the Bergen method of weather analysis the author considers the general principles by which the internal connection between the meteorological elements may be utilised. The existence and origin of air masses, their differences and the conservation of these properties, the connection between the sources of the air, its path and characteristic properties lead to the complete 3-dimensional field of an air mass, the condensation system and the vertical distribution. The origin and recognition of cold and warm air masses are considered with illustrations and the potential temperature distribution in each, while subpolar and subtropical masses are also taken. The origin and recognition of fronts in the troposphere are discussed in a general way, and this leads on to the kinematics and dynamics in the production of fronts. The horizontal and vertical circulations are dealt with, and the synoptic use of advertive effects in front production. The author considers that the troposphere is divided into two regions having opposed signs of energy transformation. He considers there are large frontal regions where large amounts of potential energy are concentrated, and even where kinetic energy is becoming potential, while in other regions the potential energy is unaltered, changes into kinetic or is distributed. In the former depressions are produced, and they proceed rapidly eastwards to the other regions and become violent. Orographical distribution also has an effect, and for this reason he considers the stratosphere has little effect, the seat of the depression being most probably in the lower troposphere. R. S. R.

1797. Upper Atmosphere. H. B. Maris. *Terr. Mag.* 33. *pp.* 233–255, *Dec.*, 1928, *and* 34. *pp.* 45–53, *March*, 1929.

In the absence of wind the components of a uniformly mixed atmosphere would separate by diffusion, each gas being in gravity equilibrium with its own partial pressure at all heights. With mixture by winds gravity equilibrium occurs only above a certain height, the diffusion level. The author investigates first the changes in this level for the different components of the atmosphere in winter and summer, and near the poles and the equator. In former discussions of radiative equilibrium it has been assumed there is (1) black body radiation from below, (2) uniform grey-body absorption and re-radiation by the air, and (3) uniform optical properties of the air for all altitudes, but not one of these is even approximately correct. Examination of the relative importance of the different components shows that CO_2 is more important than H_2O vapour in determining the radiant energy escaping from the earth's outer atmosphere, and conclusions are reached that the ice-ages can be explained by slight changes in the CO_2 content of the air. Considerations of the mean free path and density of the gases in the upper levels leads to the result that the atmosphere above 300 km. cannot be in a state of equilibrium, but that the percentage of very high-energy molecules would be far higher than would be given by a Maxwellian curve for thermal equilibrium. R. S. R.

1798. Atmospheric Oscillations by the Microbarograph. N. K. Johnson. *Roy. Meteorolog. Soc., J.* 55. *pp.* 19–28; *Disc.*, 29–30, *Jan.*, 1929.

From an analysis of the microbarograms at Calshot, Croydon, Sealand, and S. Farnborough the frequency of the occurrence of different oscillations was extracted. Experiments on the rate of decay of the oscillations indicate that they are recorded free from large errors due to instrumental causes. A comparison of S. Farnborough records of temperature lapse rates and oscillations supports the view that the relation established by Brunt [see Abstract 1667 (1927)] applies to oscillations in the lower atmosphere. The author concludes that one has to deal with resonance of the lower atmosphere to wave motion at the interface of two currents, probably at a height of 1 km., and the most frequent lapse rate of temperature gives a period of 10 minutes, the value found at Calshot and Croydon. During the day, and in summer especially, superadiabatic lapse rates exist and oscillations are much damped. Changes of period are considered to be caused by alterations in temperature of one current forming the discontinuity. In the *Discussion*, **R. Corless** referred to the periodic variations of wind speed and direction noticed on the Southport anemograms.
R. S. R.

1799. Mean Maximum Rain Falling in a Time *t*. H. Jameson. *Roy. Meteorolog. Soc., J.* 55. *pp.* 31–36, *Jan.*, 1929.

From Ceylon rainfall studies the author showed that $R = Qt^k$, where

R is the mean maximum of the total rain falling on *t* consecutive days, and Q and *k* are constants for a given station. This holds for at least ten days for all rainfall stations in Ceylon, and longer in some cases. The author extracted the maximum values for Batavia, Hongkong, and New York for 1–10 consecutive hours and 1–10 consecutive days, and also for Colombo for 5, 10, 15, 20, ... 60 minutes. For the longer periods a linear relation is obtained when log R and log *t* are plotted, but for shorter periods the graphs are curved. The values of *k* for Batavia, Hongkong, and New York agree well with the Ceylon values, but generally *k* appears to be greater for depressional than for monsoonal rainfall stations. R. S. R.

1800. Average Seasonal Rainfall over Europe. J. Glasspoole. *Roy. Meteorolog. Soc., J.* 55. *pp.* 55–69; *Disc.*, 69–71, *Jan.*, 1929.

The author extracted average monthly values of rainfall for 650 European stations, 200 of these being in the British Isles. The data are ample for Northern, Western and Central Europe, but less so for South-East and East Europe. The monthly averages are expressed as percentages of annual averages, and are also grouped in seasons. Maps illustrate the distribution over Europe for (1) the winter half-year (October–March), (2) spring (March–May), summer (June–August), autumn (September–November), and winter (December–February) seasons; (3) the typical summer and winter months, July and December respectively; and (4) the variation in range of the average monthly rainfall amounts across Europe. The prominent features of each of these charts are discussed. In the *Discussion*, **E. Gold** raised the question of probable errors in measurements because of snowfall and of over-exposure at high altitudes, but the author considered the errors were not large. R. S. R.

1801. Electrical Methods of Prospecting. F. Vercelli. *Accad. Lincei, Atti*, 8. *pp.* 342–347, *Nov.* 11, 1928.

Experiments show that the use of armoured cable to connect generator and field instruments considerably reduces disturbance and interference. The vectors of the earth's field become nearly horizontal, so that an inclination of more than 3° indicates heterogeneity of the subsoil. Moreover, elliptical polarisation is practically suppressed, and any polarisation effects appearing also indicate geological heterogeneity. W. A. R.

1802. Diurnal Variations in Rate of an Astronomical Clock and their Relation to Earthquakes. M. Ishimoto and K. Tuzi. *Imp. Acad. Tokyo, Proc.* 5. *pp.* 17–20, *Jan.*, 1929.

Certain variations in the astronomical clock at Tokyo Observatory are shown to coincide in time with certain earthquakes. After considering all possible causes the most plausible explanation is shown to be a change in gravity due to magmatic change low down in the crust. The value of further investigations on these lines is urged. C. A. S.

ASTROPHYSICS.

1803. Presence of D_3 Absorption Line in Solar Spectrum. S. B. Nicholson and N. G. Perrakis. *Comptes Rendus*, 188. *pp.* 41–43, *Jan.* 2, 1929.

Helium is usually found in the chromosphere, but sometimes D_3 is seen as an absorption in the Fraunhofer spectrum of particular parts of the solar disc. The authors have searched for it with the Mt. Wilson tower telescope from April–September, 1928, both visually and photographically, in all regions, quiet or disturbed, and have found it chiefly in the regions between members of the same sunspot group. Buss has seemed to find it in all parts of the disc, and it is possible that he has confused it with an atmospheric line at λ5875603—that is, 0·017 A distant from D_3. They give microphotometric studies of solar plates for April 19 and June 24, 1928. It is only in regions covered by faculæ, where there is no visible spot, that the authors have observed the D_3-line, and they explain it by the higher temperature of faculæ as compared with the mean temperature of the solar atmosphere. A. S. D. M.

1804. Intensity Measurements of Fraunhofer Lines. M. Minnaert and B. van Assenbergh. *Zeits. f. Physik*, 53. 3–4. *pp.* 248–254, 1929.

Measurements of the intensities of fifty-seven Fraunhofer lines of the sun's spectrum between $\lambda = 4400$ Å. and $\lambda = 4550$ Å. were made, in order to ascertain what total energy in the lines in the Rowland scale had disappeared. The total surface of the intensity curves of the lines is taken as a measure of their strength [see Abstract 624 (1928)], and it is found that the Rowland intensity scale is satisfactory for this wave-length range. The connection between the absorbed energy and the number of absorbing atoms N is obtained by combination of the results obtained with those of Russell, Adams and Moore [see Abstract 3196 (1928)], and is found to be approximately proportional to $N^{\frac{1}{2}}$. R. C. F.

1805. Spectroheliograph Determinations of Vapour Levels in the Reversing Layer or Base of the Chromosphere. L. d'Azambuja. *Comptes Rendus*, 188. *pp.* 380–382, *Jan.* 28, 1929.

The levels of rays determined from the reversing layer during eclipse are distinctly higher than those found from rays in the solar spectrum prolonged beyond the sun's limb. The author determines with the spectroheliograph the true levels of the rays not shown in the reversing layer by comparing the diameters of the images found successively by the light of a ray and by that of the neighbouring continuous spectrum. The seven rays of the reversing layer, the two infra-red rays of the ionised calcium, and the violet line K of calcium are determined in this manner. Each image is limited to a narrow portion containing the sun's vertical diameter whose two extremities passed simultaneously before the slit, and are therefore free from errors of motion of the cœlostat, etc. The levels of the seven rays are found to vary like those determined by Mitchell in the 1905 eclipse, but the amplitudes of the variation are much reduced; the depths of the two infra-red rays of ionised calcium are a little feebler than those observed by C. Davidson, out of eclipse with a slit spectrograph; and, finally, the K_3 level agrees well with that found by St. John at Mt. Wilson. A. S. D. M.

1806. Solar Rotation from H and K Lines in Prominences. J. Evershed. *Roy. Astron. Soc., M.N.* 89. *pp.* 250–254, *Jan.*, 1929.

A continuation of the 1927 investigations [see Abstract 858 (1928)], but with a change of method by using the directly measured shifts of the H and K lines instead of the indirectly measured Fe lines, which should yield a more satisfactory value of the Einstein effect. For the rotation, 289 prominence images were measured and divided into two groups, 180 Class A spectra with straight narrow lines and 109 Class B with more or less ill-defined or wavy lines; the B spectra yield values of the rotation shift 15 % larger than the A spectra. The latter give a sidereal rotation, $v = 2 \cdot 299$ km./sec., and a daily rotation at mean height 34 in. of $\xi = 16^\circ \cdot 9$, which is a reduction of the 1927 result (20°). For different latitudes the values of ξ are in good agreement with the 1927 series, and do not indicate any diminution of angular speed except in the 9° zone. The value of speed for south latitude 25° is high in both years, but it is not known if this is accidental or due to sunspot frequency. There seems to be a 4 % increase in angular motion for the increase of height from 20 in. to 60 in. The general H and K shift gives an unexpected increase of 0·003 Å. for the Einstein shift on the 1927 results. A. S. D. M.

1807. Revival of Activity in Jupiter's Southern Hemisphere. F. J. Hargreaves, B. M. Peek and T. E. R. Phillips. *Roy. Astron. Soc., M.N.* 89. *pp.* 209–214, *Dec.*, 1928.

An account of the recent disturbances on Jupiter and the phenomena of its earlier stages between the middle of August and end of October, 1928. In 1927 the great red spots regained some of their original redness, and later were companioned by dark spots near the centre of the disturbance which moved both in the *following* and the *preceding* directions. Some of the spots have given the longest Jovian rotation period (9 h. 59 m. 3.6 s.) on record. The authors describe the reactions between certain of the objects and the red spot, the colour changes of the red spot, and of the south equatorial belt, and spots that appeared as bright projections at the limb. Plates are given of the progress of the disturbance and of a chart of all the longitude determinations in the region of the south equatorial spot and south tropical zone. A. S. D. M.

1808. Study of Radiative Equilibrium. A. Véronnet. *Bull. Astronomique*, 5. 6. *pp.* 405–433, 1928.

The author determines the general solution of radiative equilibrium by surface conditions. He criticises the formulæ of Jeans, Milne, Schwarzschild and Eddington, and especially the last: for introducing radiation-pressure as an essential to the theory instead of as a mere accessory; for assuming an absorption coefficient so large (10,000 greater than for known temperatures) as to render negligible all terms beyond the first; for using it right up to the interior; and for counting the ratio of radiant energy to gravity as constant throughout the layers. For the relation between the effective temperature (T_e) and that (T_i) of the most superficial layers, he points out that Schwarzschild's formula gives too low a value of T_i for the earth as measured from Mars, and that Jeans's formula gives a truer value. From the equation of the general conditions of radiative equilibrium [see Abstract 497 (1926)], which is defined by relations entirely different from those of adiabatic [see Abstract 1111 (1924)], he draws the following conclusions: the density (ρ) first increases then decreases with the depth, giving a critical layer; if ρ varies with the temperature, it decreases to three-fourths the limiting gas density, and the inflection in the density curve is when $\rho = 0 \cdot 146$ the same limit; these density values occur at small pressures (say, 9600 atm.) and depths (some hundred km.) below the visible surface of the sun or star; they are independent of the absorption coefficient and hold good for a mixture of gas and vapour; between the photosphere and the critical layer, the only law applicable is that of the actual gas, for the laws of the perfect gas and Eddington's formulæ hold good only for

the very deep layers, and there radiative equilibrium is impossible; radiative equilibrium is not possible except in great giants like Betelgeuse.
A. S. D. M.

1809. Optical Reflection Experiments and Dyssymetry of Space. E. Esclangon. *Comptes Rendus*, 188. *pp.* 146–148, *Jan.* 7, 1929.

In 1915 the author asked how far, experimentally, the degree of approximation of the reflection laws would allow us to affirm that they were independent of the observer's motion and were not variable with orientation of the rays. In 1920 he devised an instrument for testing this, and described it, and the results obtained in 1926 and 1927 indicated how successful observations might be made. The movements of the soil or the fluctuations of the instruments produce effects twenty times as great as those sought if the experiment is prolonged more than half an hour, so they must be confined to less than a minute; in this case the fluctuations will be of the order of 1/100 of a second. The entire apparatus must act as a rigid whole, and be of even temperature throughout; it must allow of a comparative sounding of space in less than two minutes in two directions of space; but the operation can and should be repeated a great number of times. Since the flexion effects (if the inclination be changed) may be fifty times that of the effect investigated, the whole apparatus must turn with smoothness and precision about a vertical axis.
A. S. D. M.

1810. Cosmic Rays and a Cyclic Universe. E. C. Stoner. *Leeds Philosoph. & Lit. Soc., Proc.* 1. *pp.* 349–355, *Jan.*, 1929.

Criticises the Millikan theory of a cyclic universe on the ground that the only source of energy which is compatible with the observed radiation from stars and their estimated ages is the annihilation of matter. The estimate of the wave-lengths of cosmic rays from their absorption coefficients is very uncertain. If the Klein-Nishina formula is used instead of that originally given by Dirac, two of the absorption coefficients given by Millikan agree fairly closely with those calculated for the primary and secondary rays resulting from electron-proton annihilation. The interpretation of the rays as due to atom-building from electrons and protons involves the existence of processes the probability of whose occurrence seems vanishingly small. Even if there is an upbuilding of atoms in the way suggested by Millikan, and the purely speculative crystallisation of electrons and protons from radiation is assumed, it is not possible to build up a complete cycle for the universe without assuming quite arbitrarily the existence of additional highly improbable processes. The available evidence suggests strongly that the universe is changing irreversibly. [See Abstract 253 (1929).]
E. E. F. d'A.

1811. Measurement by the Interferometer of the Wave-Length of Double Stars and of its Variation with the Zenith Distance. M. Maggini. *Accad. Lincei, Atti*, 8. *pp.* 376–380, *Nov.* 11, 1928.

The author has previously described a simple method of determining by means of the interferometer the effective wave-length of the stars, and in the present note gives an account of his recent study of the variation of the wave-length with the zenith distance.
J. J. S.

1812. Temperature Radiation of the Fixed Stars. A. Brill. *Zeits. f. Physik*, 52. 11–12. *pp.* 767–794, 1929.

The first part of the paper is an elementary statement of the nature of radiation from the different layers of the stellar photosphere, and gives a general idea of the methods used to obtain the effective temperature of the star. If the star behaves like a black body, all methods would give the same value, which would be the true temperature of the radiating layer. Experience shows that Planck's radiation equation only gives approximate values for the intensity distribution in the star spectrum. Spectrophotometric observations for a given star yield different temperatures according to the region of the spectrum observed. When the temperature is determined from the temperature of the radiation, different values are again obtained. In order to bring out the different character of the temperatures, the author has introduced the idea of "colour-temperature" and "radiation-temperature." The colour-temperature refers to the form of the energy curve, and corresponds to the temperature of a black body which has the same form of energy curve as the star. The radiation temperature for a given region of the spectrum is that temperature which a black body must have in order to emit a radiation in this region equal in intensity to that radiated by the star. The temperature of the star is then discussed with the help of energy curves, and the energy curves of a black body at 5000°, 6000° and 7000° C. Criticisms of the work of Wilsing and Rosenberg and others follow. The radiation-temperature of the fixed stars may be determined (1) indirectly by considering the deviation of the stellar radiation from the black body radiation obtained from spectro-photometric observations or from the photographic colour index; (2) directly from the apparent brightness if the apparent semi-diameter of the star is known. A table is given showing the temperatures of 14 bright fixed stars obtained by different authors, the method of observation in each case being stated. T. B.

1813. Composite Stellar and Nebular Spectrum of Z Andromedæ. H. H. Plaskett. *Dominion Astrophys. Obs. Victoria Publ.* 4. 10. *pp.* 119–160, 1928.

Z Andromedæ is an extremely irregular variable star of range $8^{m}.3$ to $11^{m}.3$. Spectroscopic observations have been made during the period 1923–27 inclusive, and 111 emission lines have been measured. They fall into two groups: (1) a stellar part, consisting of a strong continuous spectrum, on which are superposed numerous narrow emission lines; and (2) a nebular part, consisting of lines due to highly ionised helium, carbon, nitrogen and nebulium. The nebular lines are longer than the others and indicate a disc of diameter $0^{m}.6$. There is also a velocity difference between the two groups. The intensity distribution in part of the continuous spectrum has been determined, and also the line intensity for some of the stronger lines. The theory of the modified wedge method employed in these determinations is discussed. The total photographic magnitude of the nebula is estimated at 15^{m}. The physical interpretation of this composite spectrum is somewhat doubtful, but it is shown that Z Andromedæ is probably a very massive star with a greatly extended atmosphere, and that the nebula is physically connected with the star. M. A. E.

1814. Spectrum and Radial-Velocity Variation of Ru Camelopardalis. R. F. Sanford. *Mt. Wilson Observat. Contrib. No.* 372. *Astrophys. J.* 68. *pp.* 408–415, *Dec.*, 1928.

Fifty-seven epochs of light minimum covering an interval of 35 years are satisfactorily represented by the formula:

$$\text{Minimum} = \text{J.D. } 2417611\cdot054 + 22^{d}\!.1622E \text{ (G.M.A.T.).}$$

Twenty-four slit spectrograms were obtained between 1919 and 1928. The plot of the measured velocities against phases, computed by means of the foregoing formula, shows that the velocity oscillates periodically with the light through a total range of about 30 km./sec. The interval from velocity maximum to velocity minimum is 15 ± days, which is considerably more than half the period. Minimum and maximum light correspond closely to the epochs of the γ velocity on the rising and falling branches of the velocity-curve, and maximum and minimum velocity occur near the epoch of median magnitude on the rising and falling branches of the light-curve. The usual correspondence between velocity- and light-curves for Cepheids does not hold. If the radial-velocity variation is interpreted as the result of a symmetrical pulsation of a spherical star, maximum light synchronises with minimum diameter and minimum light with maximum diameter. The spectrum passes through three clearly recognisable stages: (1) class Roe with emission lines of hydrogen, phase $3^{\rm d}.3$–$6^{\rm d}.3$, which is near median magnitude on the rising branch of the light-curve and at velocity maximum; (2) class Ko with hydrogen lines in absorption, phase $8^{\rm d}.8$–$13^{\rm d}.0$, which is about symmetrical to light maximum; (3) class Ro, with hydrogen lines still in absorption, over the remainder of the period, which includes the epoch of light minimum. The relations between the light- and velocity-curves at the four crucial phases of maxima and minima for these curves would be explained were it possible to assume that the star is spheroidal, with the axis of rotation pointed towards the earth, and that it oscillates with no volume change through varying degrees of oblateness. AUTHOR.

1815. Orbits of A Persei and H.R. 8210. W. E. Harper. *Dominion Astrophys. Obs. Victoria, Publ.* 4. 11. pp. 161–169, 1928.

A. PERSEI.—Thirty-seven single-prism plates of this F-type star were accumulated during the years 1922 to 1928. Both component spectra are shown in nearly equal intensity. The period was difficult to obtain by reason of the fact that the spectra were resolvable only 10 % of the time. This was due not only to a small range of velocity, but also to an unusually high eccentricity. The period is 30·4338 days, and eccentricity 0·612. The minimum total mass is 1·89 times that of the sun.

H.R. 8210.—Eighteen spectrograms of this spectroscopic binary of type A3, taken since 1922, show a circular orbit with a period of 21·724 days and a semi-amplitude of 41·45 km. per sec. AUTHOR.

1816. Analysis of Nechvile's Proper Motions. W. M. Smart and H. E. Green. *Roy. Astron. Soc., M.N.* 89. *pp.* 147–157, *Dec.,* 1928.

Twenty-two regions have been photographed in the period 1886–89, and again with the same Paris instrument in the period 1922–24, whose resultant stellar proper motions exceeding 2″ per century have been published by Nechvile. The authors analyse these on the assumption of Dyson's law of stellar density. The drift constants derived from such restricted motions do not refer to the true drifts; the frequency distribution in the pseudo-drifts, however, do not differ appreciably from the true drift distribution, but the pseudo-drift velocity is greater than the true [see Abstract 2340 (1928)]. They find: for the drift constants, the R.A. and Dec. of apex and the drift velocity respectively for Drift I and Drift II to be 92°, 0°, 1·34 and 265°–53°, 0·91; for the vertex of star streaming, R.A. 90° and Dec. + 21°; and for the constants of solar motion, R.A. and

Dec. of apex of solar motion 277° and + 42°, velocity 0·54. They take their results as lending some support to the thesis that the assumed density law is at least a good first approximation when dealing with the problem presented by the frequency distributions of restricted proper motions.

A. S. D. M.

1817. Faint Stars in Selected Areas with Large Proper Motion. Fourth List. H. Knox-Shaw. *Roy. Astron. Soc., M.N.* 89. *pp.* 267–268, *Jan.*, 1929.

A list of 24 stars from 15 areas with proper motions as large as 0″·1 per annum. The proper motions are subject to corrections for the magnitude equation.

A. S. D. M.

1818. Galaxy Rotation. H. Mineur. *Comptes Rendus*, 188. *pp.* 236–238, *Jan.* 14, 1929.

The author investigates Oort's and Plaskett's results [see Abstracts 2688 (1927) and 2097 (1928)]. He obtains for a star's angular velocity at distance ρ from the axis of rotation and ζ above the plane perpendicular to it, $\Omega = C + A\rho + B\zeta + \dots$ and analyses 2149 Lick radial velocities in the form $V = k + \phi_1(\alpha, \beta, \gamma) + r\phi_2(\alpha, \beta, \gamma) + \dots$, where r is the mean distance of the stars. The first degree terms, ϕ_1, denote the sun's motion and the second degree, ϕ_2, the galactic rotation. He express $\phi_2 = \psi_1 \cdot \psi_2$, where $\phi_1 = 0$ is the plane passing through the sun and rotation axis, $\psi_2 = 0$ is the plane perpendicular to this, and both ψ_1 and ψ_2 are linear. By least squares he gets an equation which should give three roots, of which $s_1 = 0$ and s_2, s_3 should be equal and opposite; the figures actually obtained are $s_1 = +0{\cdot}0109$, $s_2 = +3{\cdot}0684$, $s_3 = -2{\cdot}6995$. The principal directions of ψ_2 are in galactic longitude and latitude, Ox' (231° 47′, + 0° 27′), Oy' (324° 23′, + 80° 1′), Oz' (322° 36′ − 11° 12′). He interprets his results as that naked eye stars have a rotation round an axis near Ox', in the constellation Carina, which is the centre of the local cluster. He cannot reconcile this with Oort and Plaskett, and argues that these have studied distant, not local cluster stars, and that the rotation they have found is that of the galaxy, whilst the author has brought out that of the local cluster. Taking km./sec. and the parsec as units, he finds $Ar_0 = -0{\cdot}011$, $Br_0 = -0{\cdot}055$.

A. S. D. M.

1819. Determination of Galactic Pole from Selected Areas Data. J. Baillaud. *Comptes Rendus*, 188. *pp.* 377–379, *Jan.* 28, 1929.

The author has shown that the stars in the Paris Astrographic Zone give a different galactic pole from Gould's (adopted by Kapteyn), and also from Seares'. He therefore applies the same method to the selected areas as he applied to the astrographic stars; this method, which is described, presumes an approximately symmetrical plane for the galactic cluster, and that the sun is near that plane. The author finds graphically the position of the galactic pole; gives two diagrams based on the number of the stars up to 13·5 and 15·25 magnitudes, showing that the position of the pole is not closely defined, and that both figures tend to indicate the same mean pole at R.A. = 193°·7, D = + 27°·1, the circle of uncertainty being about 2° in diameter; and urges that the method of discussion shows clearly that for different longitudes, not only does the value of condensation of the stars vary, but also the plane of greatest condensation, and these two variabilities are such as to do away with the practical utility in a table of mean stellar distribution.

A. S. D. M.

1820. Rotation of Stars. G. Shajn and O. Struve. *Roy. Astron. Soc., M.N.* 89. *pp.* 222–239, *Jan.*, 1929.

A short history is given of previous investigations. Double stars, immediately after fission, should have identical rotation and orbital revolution as is shown in β Lyræ. The authors consider W Ursæ Majoris, and find that in a spectroscopic binary the rotational velocity is directly proportional to k and inversely to $P^{\frac{1}{3}}$; for the influence of rotation on line-contour they find that the lines deviate considerably from $I = F(\lambda) = I_0 e^{-k^2(\lambda-\lambda_0)^2}$, and modify this for spherical stars with and without darkening at the limb. They give a diagram of the Y Cygni intensity curve and a table of the central intensity of lines of the rotating stars, W Ursæ Majoris, Y Cygni, Z Herculis and *u* Herculis; the widening is pronounced and the line depth is decreased, giving a sensitive criterion for stellar rotation (above 30 km./sec.). Rotational effect depends on the line's initial density, and can be studied (1) by subdividing the stellar groups so that their rotations differ systematically, other influences being constant, and (2) in eclipsing variables at epochs near mid-eclipse. Rotational effects predominate in spectrocsopic binaries of short period and large velocity amplitudes; short periods have a tendency to be associated with nebulous lines; the existence of fast rotation in short period spectroscopic binaries is established. The authors test the rotational effect in the spectrum of Jupiter, and find a limit of the order of 25 km./sec.

A. S. D. M.

1821. Pokrowski' sTheory of the Upper Limit of Mass for a Star. W. Anderson. *Zeits. f. Physik*, 53. 7–8. *pp.* 597–600, 1929. *In German.*

According to Eddington's well-known theory, the greater the mass of a star the less stable must its equilibrium be, so that the existence of stars with unusually great mass is very improbable. Pokrowski has recently established an upper limit for stellar mass, by an independent and different method [see Abstract 2641 (1928)]. In this paper it is shown that the author, about six years ago, reached a similar result, working along different lines.

M. A. E.

1822. Deviation of Stellar Atmospheres from Thermodynamic Equilibrium. B. P. Gerasimovič. *Roy. Astron. Soc., M.N.* 89. *pp.* 272–280, *Jan.*, 1929.

The recent work of Adams and Russell [see Abstract 3197 (1928)] showed that there appeared to be a conspicuous and widespread deviation from thermodynamic equilibrium in stellar atmospheres. The present author, in considering the same effect, first derives a generalised Boltzmann formula for an atmosphere with a temperature gradient. He assumes that the velocity distribution of the electrons in the reversing layer is spherical and Maxwellian, that there is a balance between the total number of transitions of all kinds into a given state and the total number of inverse processes, and that, as a first approximation, the ionising power of the radiation of the reversing layer "from above" can be neglected in comparison to the stream of radiation "from below." It is further shown that a temperature gradient cannot produce noticeable deviations from the Boltzmann law. Considering red super-giants, for which the numerical data are sufficiently reliable, it is shown that the abnormal increase of the number of atoms in the higher quantum states may be attributed to abnormalities in the exciting radiation, caused by direct or indirect effects of absorption lines and bands.

R. C. F.

LIGHT.

1823. Variations in Brightness of the Night Sky. J. Dufay. *J. de Physique et le Radium*, 9. *pp.* 390–408, *Dec.*, 1928.

Both visual and photographic methods were used to compare the night sky with neighbouring stars. Results are given for the polar region for 120 nights, and the distribution of intensity across the sky is also studied. The sky brightness is relatively insensitive to atmospheric changes, but was found to increase from 1925 to 1926. The results are discussed in connection with those of Rayleigh [see Abstract 2345 (1928)]. Taking into account diffusing layers in the atmosphere, it is deduced that feeble stars produce about 3/10 of the brightness of the sky. F. S.

1824. Influence of Temperature on Absorption of Tourmaline. P. Leroux. *J. de Physique et le Radium*, 9. *pp.* 365–376, *Nov.*, 1928.

Measures the absorption of waves comprised within 5790 and 3655 Å. at various temperatures by means of a photoelectric cell and electrometer. One specimen of tourmaline was cut parallel to the axis, and the other perpendicular to it. Under these conditions there is a linear variation of the absorption with temperature up to about 250°. This variation is reversible, but on further heating the absorption is permanently reduced. The slopes of the curves obtained depends upon the direction of vibration and propagation of the light. It diminishes with increasing wave-length and reverses at a certain wave-length. [See also Abstract 94 (1929).]

E. E. F. d'A.

1825. Binocular and Monocular Vision. E. M. Lowry. *Kodak Research Lab., Comm. No.* 380. *J.O.S.A. and R.S.I.* 18. *pp.* 29–40, *Jan.*, 1929.

Describes the results of a preliminary study of the brightness sensibility of the human eye as related to tone reproduction problems. Attempts to apply available data on retinal brightness sensibility have shown than these data are inadequate. Further, there is a discrepancy between theory and practice, probably due to the previous results being obtained with monocular vision, and to the fact that in the majority of cases some sort of optical system or artificial pupil was used between the eye and the visual field. The present author describes a new type of apparatus in which as large an area of the retina as possible is brought to a definite condition of adaptation, whilst there is no optical system at all between the eye and the visual field. Arrangements are also made for the use of either binocular or monocular vision. From the results obtained for the contrast sensibility of the retina it is shown that for brightnesses below 50 millilamberts there is a considerable difference between binocular and monocular vision, the difference increasing with decreasing test field brightnesses. At 50 millilamberts the two types of vision have nearly the same value for the higher test field brightnesses, but are again considerably different at the lower values. The condition of light adaptation of the eye is also considered, and it is shown that although there is a large difference at low brightnesses between binocular and monocular vision, as the adapting field brightness is raised, this difference decreases, tending to disappear with very high adapting field brightness values. R. C. F.

1826. Reflecting Power of the Soil. L. Martinozzi. *N. Cimento*, 5. *pp.* 318–325, *Aug.–Sept.–Oct.*, 1928.

A discussion of experiments made with the photometer of L. F. Richardson with the object of measuring the reflecting power of the ground. The results were diverse and unsatisfactory, which the author imputes to the fact that the phenomenon of diffusion is completely neglected.

J. J. S.

1827. Specific Rotation and Refractive Index of a Solution. W. Perschke. *Zeits. f. Elektrochem.* 35, *pp.* 17–18, *Jan.*, 1929.

The relationship between the specific rotation and the refractive index was examined for solutions of camphor in alcohol and in benzene, and tartaric acid in water. It was found that a simple logarithmic relationship existed, and if (α) is the specific rotation and n the index of refraction, then $\log . (\alpha) = a + b . \log . n$, where a and b are constants which are independent of the concentration.

F. J. B.

1828. Birefringence and Dichroism of Thin Iron Layers obtained by Distillation. M. Cau. *Comptes Rendus*, 188. *pp.* 246–249, *Jan.* 14, 1929.

The author has established formulæ which give the ellipticity (E) and rotation (R) in terms of the azimuth (A). The curves are not truly sinusoidal. A comparison is tabulated showing the calculated and observed values of R and E for each 15° change in A and the correction terms ΔR and ΔE for the second approximation. Theory and experiment show good agreement. [See also Abstract 2103 (1928).]

R. S. R.

1829. Super-Dispersion. T. Takeuchi. *Zeits. f. Physik*, 53. 1–2. *pp.* 148–150, 1929.

In a recent paper the author, using the Schrödinger wave equations, has dealt with the refraction of light quanta or "photons" in "empty" space, in a curved universe. The refractive index of empty space n is equal to $1/\sqrt{1 - \nu_0^2/\nu^2}$, where ν is the frequency of the light considered and $\nu_0 = c\sqrt{\lambda}/2\pi$, λ is the cosmological factor and ν_0 is the critical frequency; at this frequency each quantum of the ν wave gives up its motion to any super-corpuscle which it meets. $\nu_0 = m_0c^2/h$, where m_0 is the mass of the photon at rest, $\nu = mc^2/h$, where m is the mass of the photon in motion. If λ is about 10^{-52} cm^{-2}, m_0 is about $0 \cdot 4 . 10^{-63}$ gramme. An estimate of the possible size of the photon is made. Equations are given for the loss of the intensity of the light due to collisions with the super-corpuscles.

H. N. A.

1830. Quantum Mechanical Dispersion Formula for Atomic Hydrogen in the Ground State. F. Reiche. *Zeits. f. Physik*, 53. 3–4. *pp.* 168–191, 1929.

The author discusses the formula for the dispersion of atomic hydrogen in the ground state, given by Podolsky [see Abstract 1898 (1928)], and shows that, although different in outward form, it is identical in substance with the Ladenburg-Kramers dispersion formula. In the analysis a rigid verification of the Thomas-Kuhn F-sum law relating the "dispersion intensities" of the series lines is given for the present case. Podolsky's formula is employed to derive the absorption in the continuous spectrum and the refractive index for very high frequencies.

W. S. S.

1831. Universal Optical Law. M. Herzberger. *Zeits. f. Physik*, 53. 3–4. *pp.* 237–247, 1929.

Derives, from the conditions of Malus's law, a general optical law which satisfies not only a large number of known optical laws, but also some laws hitherto unknown. A translation of Malus's law on regular surfaces, previously unknown, is developed from a specialised treatment of the law, as are also Fermat's law, the basic principles of the Eikonal theory and a new generalisation of the Straubel laws regarding the representation of line elements by an infinitely thin pencil of rays. Finally, the cosine law, in its general form, is derived, whilst the representation by an optical system of line elements of the infinitely distant plane, which has not previously been examined, is considered. R. C. F.

1832. Preparation and Study of Beryllium Glasses. C. F. Lai. *Univ. Pittsburgh, Bull.* 25. *pp.* 65–73, *Oct.* 25, 1928.

Eighty different Be glasses were prepared and, after test, distributed on a triaxial diagram to indicate areas of good glass, devitrifiable material, unmelted mixes, etc., in the soda-beryllia-silica group. Four series from the clear glass area were examined for density, hardness, refractive index and ultra-violet light transmission. For comparison a Ca and Mg glass was included in each series. Extreme transparency, high melting point, and great hardness were obtained in some cases. The ultra-violet transmission decreases with increased BeO content, and the purity of the materials seems important. The results obtained are summarised in a table, and spectrograms are reproduced. R. S. R.

1833. Refractometer. *Rev. d'Optique*, 7. *pp.* 503–509, *Dec.*, 1928.

Particulars are given of a new type of Pulfrich refractometer for determining very rapidly and accurately the refractive index of samples of glass. The whole apparatus is designed to be very rigid, and practically not derangeable, while all parts are easy of access to the operator. The azimuth scales can be read to 0·01°, and by a special adjustment only one angular measurement is required to get the angle of emergence α when total reflection is just produced. Values of α and the corresponding index of refraction n are tabulated. An accuracy of 0·00001 for n is claimed.

R. S. R.

1834. Number of Images produced by Two Mirrors at an Angle. I. Würschmidt. *Phys. Zeits.* 30. *pp.* 27–30, *Jan.* 1, 1929.

A simpler method than that of Oryng [see Abstract 1229 (1928)] for calculating the number of images of a point lying between two mirrors S_1 and S_2, at angle $\phi = \phi_1 + \phi_2$, where ϕ_1 is greater than ϕ_2. If $(180° + \phi_2)/(\phi_1 + \phi_2) = k + \beta$, where k is an integer and β a proper fraction, the number of images may be $2k$, $2k + 1$ or $2k - 1$. This last number will also occur when $180°/(\phi_1 + \phi_2)$ is an integer, even or odd, and $\phi_1 = \phi_2$, because two images of odd numbers due to S_1 and S_2 may coincide. Reference is also made to Maurer [see Abstract 1540 (1928)].

H. B.

1835. Striae Method for Dark Field Illumination in Microscopes. W. Kraemer. *Zeits. f. Instrumentenk.* 49. *pp.* 33–36, *Jan.*, 1929.

Describes the construction of a striæ microscope, this type having been somewhat neglected owing to the development of new methods of dark field illumination for normal microscopes. Examples of the uses of the method—crystallisation observations and work on the paraffin content of transformer oil—are given, whilst further possible uses are suggested. Performance limits for the model described are also stated. R. C. F.

1836. New Type of Microscope Stage Fine Adjustment. K. John. *Zeits. f. Instrumentenk.* 49. *pp.* 36–40, *Jan.*, 1929.

Briefly examines the methods in use at the present time for finely adjusting the microscope stage, giving the conditions which should be satisfied by a good adjusting device. These conditions are fulfilled in a mechanism described by the present author, with which an adjustment as low as $12 \cdot 0 \times 10^{-5}$ millimetre can be obtained, this degree of adjustment being twelve to forty times better than at present possible. R. C. F.

1837. Microscope Image Phenomena. C. Lakeman and J. T. Groosmuller. *Zeits. f. Physik*, 53. 7–8. *pp.* 574–580, 1929.

An investigation of phenomena obtained in the formation of an image of a non-self-luminous grating is described, and the Abbe and Berek theories are extended. The phenomena obtained when the source of illumination is an aperture of *finite* size are discussed particularly. W. S. S.

1838. Spectrograph Objective possessing a Focal Length Constant to One-Thousandth between 1850 Å. and 7000 Å. P. Bricout. *Comptes Rendus*, 188. *pp.* 324–326, *Jan.* 21, 1929.

The author shows that an objective consisting of quartz and fluorine with a layer of water between them gives a remarkable degree of achromatism. For the range 1854 Å. to 6708 Å. the results of test show deviations not exceeding 1/1000. A doublet of quartz-fluorine shows larger errors over this range. With this new objective the photographic plate can be arranged normal to the light and at a constant distance for the range of wave-lengths. R. S. R.

1839. Nineteenth Annual Exhibition of the Physical and Optical Societies. W. B. Coutts and D. J. Scourfield. *Journ. Sci. Instruments*, 6. *pp.* 65–69, *Feb.*, 1929.

Notes on exhibits: Optical instruments; microscopes. A. D.

1840. Hydrogen Ion Colorimeter. J. J. Beaver. *J.O.S.A. and R.S.I.* 18. *pp.* 41–49, *Jan.*, 1929.

Particulars are given of a colorimeter similar to the standard type, but having an added cup and plunger, and which is used for measuring the pH of solutions. The method is rapid and accurate, and can be used on coloured or turbid solutions if the colour is not too deep. The results obtained with ten different indicators are given at approximately every $0 \cdot 2$ pH over their ranges. The instrument can be used as a regular colorimeter by removing the added plunger and cup. R. S. R.

1841. Kerr Constant of Nitrobenzene. R. Möller. *Phys. Zeits.* 30. *pp.* 20–24, Jan. 1, 1929.

Preliminary communication. Nitrobenzene has the highest-known Kerr constant B, and is therefore utilised for television, but the values of different experiments are very discordant, partly because nitrobenzene readily absorbs moisture. The author excludes all air access from his Kerr condenser. The difficulty in securing complete darkening of the field, especially for path differences (between the parallel and vertical components) of $\Delta = \frac{1}{2}$ and 1, is ascribed to the non-uniformity of the field intensity, which increases rapidly, particularly between the central portion of the cell and the kathode, as observed by Lohaus [see Abstract 1560

(1926)] and Ilberg [see Abstract 98 (1929)]; for $\Delta = 0 \cdot 7$ this want of uniformity amounts to 10 %. It is due apparently to some electrolytic impurity which is deposited during the experiment. A Koch-Goos microphotometer is used. The mean value found is $B = 3 \cdot 47 \times 10^{-5}$ at 20°. H. B.

1842. Method for the Measurement of Weakly Elliptically Polarised Light in the Ultra-Violet. G. Szivessy and C. Münster. *Zeits. f. Physik,* 53. 1–2. *pp.* 13–51, 1929.

The method described is a suitably modified form of Sénarmont's method for determining the constants of elliptically polarised light in the visible region. The precision attained is such that the azimuth of the elliptical vibration is determinable to a fraction of a minute, and for an ellipticity of 0·005, the error is of the order of 1 %. Full details are given of the apparatus (including a specially designed spectral polarimeter), and of measurements made to determine the accuracy obtainable.

W. S. S.

1843. Apparent Mie Effect and its Possible Rôle in Atmospheric Optics. G. I. Pokrowski. *Zeits. f. Physik,* 53. 1–2. *pp.* 67–71, 1929.

Considers the possibility of interference of light which is scattered from different centres, and shows that under certain conditions the greater part of the light will only be deflected a very little from its original direction. The theory is employed to explain the terrestrial atmospheric " corona " round the sun, and satisfactory agreement with observation is obtained; it appears that the scattering centres in the atmosphere are mostly smaller than the wave-length of light. An experiment was made in which a small volume of air was strongly illuminated, and the spectrum of the scattered light photographed with an exposure of about 10 hours; the primary and secondary spectra were measured photometrically, and it appeared that between 5200 Å. and 2500 Å. the intensity of the scattered light was approximately proportional to λ^{-4}. It follows that the scattering centres must be so small that Rayleigh's law holds for 2500 Å., and that the diameter must be less than 25 $m\mu$. H. N. A.

1844. Intensity and Temperature Relations of Combination Scattering. G. Landsberg and M. Leontowitsch. *Zeits. f. Physik,* 53. 5–6. *pp.* 439–448, 1929.

The intensity of the most intense red trabants in the light scattered by quartz reaches about 40 % of the intensity of the corresponding ground lines. With increasing temperature the intensity of the red trabants remains practically constant, the intensity of the ground lines is proportional to the absolute temperature, and the intensity of the violet trabants rises much more slowly. The statistical density or concentration variations, which alone establish the conditions in the classical scattering, have no direct relation to the combination scattering. A. D.

1845. Rotatory Power of Organic Tartrates: a Study of Strong Electrolytes. E. Darmois. *Comptes Rendus,* 188. *pp.* 388–390, *Jan.* 28, 1929.

Data are given for the rotatory powers of the tartrates of the following bases: NH_3, NH_2Et, $NHEt_2$, NEt_3, NEt_4OH, NC_5H_{11}, $NH_2 . CH_2 . C_6H_5$. In the ethylamine series there is a diminution of rotatory power, this effect being greatest in the quaternary base. Piperidine also produces a decrease of rotatory power, but benzylamine produces a large increase.

These effects are attributed to (i) a deformation of the tartrate ion, decreasing with the radius of the kation, and producing an increase of rotatory power; (ii) a dehydration of the tartrate ion, giving rise to a decrease of rotatory power. The formation of covalent molecules is not taken into account at this stage, but may be the dominant factor in the case of the primary secondary and tertiary amines [see Moore and Winmill, *Journ. Chem. Soc.*, 1912, 1635]. T. M. L.

1846. Aerial Maps. H. Roussilhe. *Comptes Rendus*, 187. *pp.* 970–972, *Nov.* 26, 1928.

A technical paper on the method of taking aerial maps. A simplification is given of the calculation of the point whence the aerial photograph is taken, by applying the method of the approximate point used by Hatt in geodesy, *i.e.*, by employing any number of measurements of the angle and by compensating them by a simple graphical construction on a large scale. This method is described by means of a diagram. The approximate position S of the optical centre of the objective at the moment of taking the picture may be rapidly obtained by the restitution apparatus. This approximation varies between 3 and 7 m. for the foot of the vertical from S and between 2 and 3 m. for the altitude. By the use of rapid plates and corrected objectives it is expected that the plane position of the point S may be defined within 2 or 3 m. and the altitudes within 1 m. J. J. S.

1847. Action of Linearly Polarised Light on Sensitive Films of Silver Photo-Chloride. L. Richard. *Rev. d'Optique*, 7. *pp.* 477–486, *Dec.*, 1928.

Silver chloride which has previously been illuminated by white light acquires the peculiar property that if exposed to monochromatic light afterwards it tends to assume the colour of such light. Weigert [see Abstracts 106 and 570 (1920) and 425 (1921)] showed that if the silver chloride exposed to white light be illuminated by polarised light, the emulsion acquires a permanent dichroism and birefringence. The present author, employing plates coated with the same emulsion as used by Weigert, has further examined this phenomenon using the yellow doublet and the green ray emitted by a mercury-vapour lamp after polarisation. The results for the effect of time of previous ripening in white light show that the amount of dichroism obtained increases rapidly up to two minutes of ripening and then falls off, tending to a steady value after a time which is dependent on the time of exposure to the polarised light. By increasing the time of exposure to the polarised light the results show a continuous increase in dichroism, except in the case of measurements in green light of the dichroism produced by exposure to polarised yellow light. In this case the value is negative just at the beginning. The birefringence also shows this change in sign in two cases, in one of which it remains negative for an exposure time up to 10 hours. R. C. F.

1848. Blackening of Photographic Plates in the Ultra-Violet. P. Lafay. *Rev. d'Optique*, 7. *pp.* 495–502, *Dec.*, 1928.

The author examines the blackening of photographic plates by ultra-violet light between the wave-lengths 4000 Å. and 2500 Å., considering only the effect of the illumination, exposure time and wave-length. A quartz mercury-vapour lamp was used as the source of ultra-violet light, and, although the light emitted by this is variable immediately on striking, it was found to become practically constant when the lamp had been running for an hour, giving maximum variations of only 3 % to 4 % of the average intensity of the light emitted. The results obtained show that the wave-length produces a considerable effect on the contrast factor of the plate, the factor increasing slightly from 2500 Å. to 3000 Å., whilst above this wave-length a rapid increase is obtained. All the plates examined show no connection at all with the law of reciprocity, but for low values of the illumination Schwarzschild's law is found to be in good agreement with the results obtained. R. C. F.

1849. Photographic Sensitivity. O Masaki. *Kyoto Coll. Sci., Mem.* 12. *pp.* 1–22, *Jan.*, 1929. *In English.*

This paper deals with the effect of heat on the sensitivity curves of photographic plates, and with the sensitivity of photographic plates at various temperatures. Earlier work by the present author had shown that previous heating of a photographic plate sensitised the plate more for rays of the infra-red than for those of the ultra-violet, although Kneller later showed that heat did not selectively influence the sensitivity of the plate. In Part I of the paper the results are given of experiments carried out in order to ascertain, at various wave-lengths, the amount of sensitisation produced by previous heating. Twelve different kinds of plates were tried, and results show that the contrast always becomes steeper, after heating, for all wave-lengths, whilst generally the inertia of high-speed plates increases and that for slow-speed and panchromatic plates decreases after heating. That the maximum point in the sensitivity curve always shifts a little towards the red end of the spectrum after heating the plate is shown by the fact that where the sensitivity is increased the amount of the increase is greater for the more refrangible rays than for the blue rays. Where desensitisation occurs, this is less for red rays than for blue rays. The sensitising action of heat on the plates is retained several hours after the plates have cooled down to room-temperature. In Part II the dependence of the inertia and contrast of the plate on its temperature is dealt with. The results show that the change in inertia is generally slow up to 30° C., becomes greater as the temperature is increased to 70° C., and again becomes slower above this temperature. The change in the contrast is small until a temperature of about 60° C. is reached, but becomes more marked at higher temperatures. The contrast is found to be proportional to e^{t^2}, t being the plate temperature in ° C., whilst a formula expressing the density as a function of the temperature is also obtained. This formula, $D = D_m e^{at^2}\{1 - e^{-(bt+c)E}\}$, where a, b and c are constants, D_m is the maximum density at 0° C., E is the exposure, and t the plate temperature, is valid from 10° to 80° C. R. C. F.

1850. Development after Fixation of Inversed or Solarised Photographic Plates. H. Belliot. *Comptes Rendus*, 188. *pp.* 167–169, *Jan.* 7, 1929.

Considers the influence of the type of fixing solution on the development after fixing of solarised plates. Experimental results obtained show that if a reducing fixing solution is used the result approaches very near to that given by chemical development before fixation. Further, by making the fixing solution more alkaline, the same evolution is given, whilst the inverse evolution is obtained if the fixing solution is made more acid. After a brief discussion of the theory involved, it is concluded that the image obtained by development after fixation is given by the molecules directly reduced by light, together with the activated molecules and a more or less large number of neighbouring molecules in the case where the fixing solution is itself capable of reducing. [See also Abstract 1517 (1929).] R. C. F.

1851. Photometric Measurements by Fringe Disappearance. L. Santon. *Rev. d'Optique*, 7. *pp.* 487–494, *Dec.*, 1928.

The conditions of the sensitivity of the eye to the disappearance of fringes is examined by considering the effect of illumination, wave-length, and size of fringes as obtained by means of the Savart plate or the Babinet compensator. It is shown that the size of the interfringe greatly affects the sensitivity of the eye to such a phenomenon, but varying the field brightness over quite a large range apparently does not produce any alteration in the sensitivity. Very low field brightness values also were experimented with. No advantage appears to be gained from the use of monochromatic light. The construction of a fringe photometer, developed from a consideration of the results obtained, is described. This instrument is quite satisfactory for the measurement of the brightness of a distant source of light, and, by the use of a diffusing screen, for the measurement of the intensity of a light source. The intensity cannot accurately be measured directly, as the obtaining of the readings is very fatiguing. R. C. F

1852. Photometry of Therapeutic Lamps. D. T. Harris. *Journ. Sci. Instruments*, 6. *pp.* 2–7, *Jan.*, 1929.

A rapid method of measuring the ultra-violet emission from luminous sources is described, involving the use of a photoelectric cell, a thermionic valve and a microammeter. AUTHOR.

1853. Integration of Light by Photo-Electrolysis. W. R. G. Atkins and H. H. Poole. *Roy. Dublin Soc., Proc.* 19. *pp.* 159–164, *Jan.*, 1929.

Describes methods whereby the light falling on a photoelectric cell is integrated over a period of time by measuring electrolytically the total quantity of electricity which has passed. This is possible because the current passing through the cell is directly proportional to the light falling on it. Using a Burt sodium vacuum cell, the current obtained was 1·15 microamperes per 1000 metre-candles, and on a bright November afternoon 10 seconds only were required for the detection of the production electrolytically of alkali in a dilute bicarbonate solution. The deposition of copper can also be brought about by means of this photoelectric current, and values ranging from 0·13 mg. for a winter day to 1·0 mg. for a summer day might be expected for the quantity of copper deposited, with the photometer in the open and placed horizontally. A distinction of 0·002 mg. per 100 c.c. in the copper contents of solutions can be observed by means of the potassium ethylxanate method. R. C. F.

1854. Calibration of the Photometric Wedge. W. Scharonow. *Zeits. f. Instrumentenk.* 49. *pp.* 27–33, *Jan.*, 1929.

The usual methods of calibrating astronomical photometric wedges do not take into consideration the difference in spectral distribution of the calibrating source of light and that emitted by the stars, or if stars are used directly for calibration, then atmospheric absorption and scintillations produce large errors. The present author theoretically considers the question from the effect of the wedge at various wave-lengths, and shows how such a wedge can be calibrated from spectrophotometric measurements, care being taken to ensure that allowances are made for personal peculiarities. For a thin glass the integral transmission coefficient is a mean between the coefficient for the radiation which is easily transmitted and that for the radiation which is badly transmitted. In the case of thick glass the coefficient of the integral transmission is nearer that for the easily transmitted radiation. R. C. F.

1855. Phosphorometer for Rapid Measurement of Phosphorescence. R. Coustal. *Comptes Rendus*, 188. *pp.* 326–327, *Jan.* 21, 1929.

The apparatus consists of a wooden or cork disc on which are supported glass tubes containing ZnS and varying amounts of phosphorogene. The luminosity is for all tubes of the same colour and decreases from one tube to the next by the factor 0·5 for the eleven tubes. The object tested is compared with the standard in the ultra-violet light from a Hg arc, all luminous rays being excluded. A rapid comparison is thus possible, while the law of decrease of the phosphorescence can be established in this way. R. S. R.

1856. Life of the Excited Molecule in Aqueous Fluorescent Solutions. S. I. Wawilow. *Zeits. f. Physik*, 53. 9–10. *pp.* 665–674, 1929.

The theory of fluorescence extinction in liquid media by means of impacts of the second order is applied to the observations of Jette and West [see Abstract 632 (1929)] on the extinction effect produced by potassium iodide. New experiments are now described on the influence of temperature upon the extinction process, the results of which confirm the theory. The life of the excited molecule, which has now been computed, is found to be in agreement with the duration obtained by Gaviola [see Abstract 2505 (1927)] from direct measurements, and appears to be independent of the exciting wave-length. This fact is discussed in connection with Lewschin and Fröhlich's depolarisation results [see Abstract 2713 (1927)] by decreasing wave-lengths. H. H. Ho.

1857. Luminescence Associated with Electrolysis. R. T. Dufford. *J.O.S.A. and R.S.I.* 18. *pp.* 17–28, *Jan.*, 1929.

Measurements are made with a number of metals of the luminescence which occurs at the anode during electrolysis. In general the light is emitted by the electrode film which enables the electrode to act as a rectifier. The effect is very marked with aluminium anodes in sodium phosphate or bicarbonate solutions, or metals in ether solutions of Grignard reagents. The brightness observed in this luminescence ranges from the threshold of visibility to above 10^{-5} "lambert"; it increases rapidly with the applied voltage until the heating of the emitting film causes it to fall with the further rise in voltage. Curves are plotted to show brightness and efficiency as functions of the applied voltage for sodium bicarbonate. The efficiency found for this luminescence ranges from 10^{-8} to above 5×10^{-6} %; it behaves qualitatively like the brightness, at first rising, then decreasing, with the applied voltage. Differences in concentration produce relatively small changes in brightness and efficiency, though an optimum concentration exists at about 5 % of sodium bicarbonate. The effects with chemically similar solutions are comparable.

Impurities generally have a small effect on the brightness and on the efficiency; the most interesting case found, that of traces of sodium hydroxide in sodium phosphate solutions, with aluminium anodes, is illustrated for several cases. [See also Abstract 3101 (1927).] J. N. P.

1858. Secondary Radiations in Light Diffused through Quartz. J. Cabannes. *Comptes Rendus*, 188. *pp.* 249–250, *Jan.* 14, 1929.

The author has previously suggested [see Abstract 463 (1929)] that the action of light on a molecule depends on the orientation of the latter. To verify this suggestion experiments have been made on crystals (of quartz), in which the molecules are oriented in a limited number of directions. The spectra of the diffused radiations always contain the same radiations, whatever the orientation of the crystals. The changes in frequency are independent of the exciting radiation, and are simple multiples of the fundamental infra-red frequencies of the crystal. When the axis of the crystal is normal to the incident and diffused rays, certain of the secondary rays are almost completely polarised in the direction of the crystal axis, but one ray is completely polarised in a direction normal to this. If the axis of the crystal is made to coincide with the direction of the incident ray, the state of polarisation of the secondary rays does not change. It appears that a certain number of vibrators must be grouped in a system possessing the symmetry of the crystal. A. J. M.

1859. Ultra-Violet Spectra Emitted by a Mixture of Hydrogen and Mercury Vapour. H. Jezewski. *J. de Physique et le Radium*, 9. *pp.* 278–296, *Sept.*, 1928.

A new system of ultra-violet bands due to mercury hydride is described. The equations giving the frequencies of the rays as functions of the quantic numbers are calculated, and the experimental investigation of the bands shows the influence of the hydrogen to be extremely characteristic. The bands only appear in its presence with an intensity more or less great which depends on the mutual correlation between the hydrogen pressure and that of the mercury vapour as well as on the electrical conditions. It is H which is the indispensable factor in the existence of the bands studied. They are emitted by a combination of Hg and H. The moments of inertia of the molecules of this compound are, however, smaller than those of the molecules emitting the bands of Hulthén which are degraded towards the high-frequency part of the spectrum, whilst the bands the author describes are degraded towards the red. The new bands appear when the tension is sufficiently high, and they may be attributed to the ions. This hypothesis is confirmed by Ludloff's rule. Quite remarkable changes of distribution of intensity occur in the continuous spectrum which accompanies the bands. These changes seem to throw some light on the mechanism of the influence of metallic vapours. Superposition of the continuous H spectrum and of the continuous spectra due to the dissociation of hydrides of the metals seems to occur. The paper is illustrated by a diagram of the apparatus used, photographs of the bands examined, and six tables showing the positions of the bands. An Appendix gives an account of experiments on the appearance of rays of high order in the arc series of the spectrum of mercury, and some facts concerning emission and absorption in band spectra of mercury vapour. J. J. S.

1860. Third Order Term of Stark Effect on Balmer Lines. S. Doi. *Phys. Math. Soc. Japan, Proc.* **10.** *pp.* 223–229, *Nov.*, 1928. *In English.*

This is an extension of Epstein's calculations [see Abstract 684 (1927)], but extended to third order terms. Two extra terms are found in the final expression as compared with the result of classical quantum conditions. Experiments with large fields [see Abstract 3239 (1928)] agree better with the later theory. The paper is mathematical. F. S.

1861. Relative Intensity of the Stark Effect Components of H_β and H_γ. H. Mark and R. Wierl. *Zeits. f. Physik,* **53.** 5–6. *pp.* 526–541, 1929.

The distribution of intensities of the components depends on the direction of the analysing electric field with respect to the direction of motion of the canal rays and also on the motion of the luminous atoms. When the field is at right angles to the direction of motion the *p* components of H_β and H_γ show a distribution agreeing with that given by Schrödinger, but there are divergences when the field is parallel, and generally in the *s* components. E. E. F. d'A.

1862. Stark Effect in Hydrogenic Atoms. V. Rojansky. *Phys. Rev.* **33.** *pp.* 1–15, *Jan.*, 1929.

The Stark effect of the fine structure of hydrogenic atoms is discussed in the light of the quantum mechanics. Explicit formulæ are given for the energy levels in either a weak or a strong electric field, including in each case both the relativity corrections and the Stark effect. (The conventional treatment neglects either one or the other.) The results are, except in form, similar to those recently given by Schlapp [see Abstract 3014 (1928)]. In the new mechanics, in contradistinction to the old Bohr theory, there is a linear Stark effect even in weak fields, because of the identity of energy for the *ns* and np_1 levels in the absence of external fields. This degeneracy is shown to account for the results of the recent experiments of Ornstein, Zernike, and Snoek [see Abstract 1620 (1928)], who found that the 2*s* level in H is not metastable. The coefficients are found for the development of the "parabolic" eigenfunctions in terms of the "polar" ones, and a set of numerical values of these coefficients is tabulated. Methods are given for the calculation of the relative intensities in the Stark effect in terms of the already theoretical fine structure intensities in the absence of fields. AUTHOR.

1863. Arc Spectrum of Tin. A. T. Williams and F. Charola. *J. de Physique et le Radium,* **9.** *pp.* 377–385, *Dec.*, 1928.

The results obtained by various other workers have been examined and all but 13 lines classified. A number of terms obey a Hicks formula, and three non-classified groups have been found with constant differences. The results are expressed in tables and a diagram. F. S.

1864. Absorption Spectra of Oxygen and Ozone in the Ultra-Violet. J. Dufay. *Comptes Rendus,* 188. *pp.* 162–164, *Jan.* 7, 1929.

Liquid oxygen and the gas at high pressure give a number of absorption bands in the ultra-violet below 2400 Å., which, according to a recent suggestion of Wulf, are due to the molecule O_4 supposed to be present in oxygen at high pressures. These bands are shown by the present writer to coincide in position, with a series of "undulations" in the main ultra-violet absorption band of ozone [see Chalonge and

Lambrey, Abstract 2525 (1927)]. It is suggested that the two series of bands may have a common origin, but further experimental work is necessary. W. S. S.

1865. Change of the Kathode-Ray Spectrum of Oxygen by Cooling with Liquid Air. J. Aars. *Ann. d. Physik,* 1. 2. *pp.* 216–228, *Jan.* 19, 1929.

The band spectra of oxygen were photographed partly at room-temperature, partly at the temperature of liquid air, in order to investigate the change produced by cooling. Reproductions of 11 spectra are given in this paper. These were chosen out of 34 which all showed the same effect. There are certain negative bands in these spectra which stand out as specially characteristic examples of non-dependence on the pressure and the tension. The positive bands which are visible in the reproductions of the glass spectrographs are not in these examples so strong that the mentioned independence can be judged of. So far as the investigation has gone the results agree in showing that the distribution of line intensity in the individual bands of oxygen gas is a function of the temperature alone, and that it is nearly independent of the pressure and the ray velocity. It is evident, however, that further researches of this kind with apparatus of greater dispersion should be undertaken. It is desirable to extend the stoves in which the tension and the pressure can be changed. The limits of the pressure in the author's work were determined by the form and dimensions of the discharge tube, and he hopes in the near future to undertake an extended research such as he mentions. J. J. S.

1866. Breadth of Resonance Lines and Possibility of a Shift towards the Red due to Frequently Repeated Scattering. W. Orthmann and P. Pringsheim. *Zeits. f. Physik,* 53. 5–6. *pp.* 367–379, 1929.

Shows that when white light passes through a gaseous atmosphere a reversal of a line may take place in the spectrum in consequence of multiple scattering, even without true absorption, when the form of the absorption lines is essentially due to the Doppler effect, or to radiation processes connected with collisions, "Stossdämpfung." This reversal, however, is not accompanied by a transference of intensity towards the red due to frequently repeated Compton effects. This is also the case when the gas is so rare that radiation due to collisions does not take place, but only free radiation, "Strahlungsdämpfung," with a relatively large Doppler effect. If the amount of rarefied gas is large and there is no Doppler effect, the repeated scattering of the free radiation from the molecules will probably produce the above shift to the red. This is of interest in connection with the spectra of certain giant stars, which show an intensity maximum in their continuous spectrum on the long wave-length side of their absorption lines. The outer atmosphere of such stars must have such a small density that true absorption is not to be expected in it, though no doubt it takes place in lower layers. H. N. A.

1867. Spectrum of Light Scattered in K_2CO_3 Solution. M. Leontowitsch. *Zeits. f. Physik,* 54. 1–2. *pp.* 155–157, 1929.

In this spectrum a trabant was found corresponding to the infra-red wave-length $\lambda_1 = 9\cdot26$. The relations of this to the trabants in calcspar are discussed. A. D.

1868. Ultra-Violet Absorption Spectrum of Nitrogen Peroxide. M. Lambrey. *Comptes Rendus*, 188. *pp.* 251–252, *Jan.* 14, 1929.

The spectrum as far as 3978 Å. has been measured by Carwile [see Abstract 1590 (1928)]. Beyond that point there are two absorption spectra. That due to NO_2 consists of two structureless bands, the one terminating about 3400 Å. and the other extending from 2400 Å. to the limit of the spectrum. That due to NO_2 has a complex structure, and tables are given of the absorption lines observed against a continuous background due to the discharge in hydrogen. F. S.

1869. Third Order Spectrum of Sulphur (SIII). J. Gilles. *Comptes Rendus*, 188. *pp.* 320–321, *Jan.* 21, 1929.

In continuation of previous work [see Abstract 1569 (1929)] the combinations of a number of lines between 2998 Å. and 2442 Å. are listed. F. S.

1870. Continuous Spectrum of Mercury Vapour. H. Volkringer. *Comptes Rendus*, 188. *pp.* 321–323, *Jan.* 21, 1929.

Mercury was heated in a silica tube by two electric furnaces, the former maintains the vapour at a temperature T_1, while the latter heats the mercury itself to T_2. The vapour was excited by an oscillating discharge, and the spectrum observed with a quartz spectrograph. For $T_2 = 70°$ there is no continuous spectrum whatever the value of T_1 between 70° and 650°. This spectrum appears at $T_2 = 130°$, and is most intense when $T_2 = 225°$. At the latter temperature the ultra-violet spectrum of the bands was examined, confirming Rayleigh's results [see Abstract 2510 (1927)]. F. S.

1871. Absorption Spectra of Certain Organic Liquids in the Near Infra-Red. J. W. Sappenfield. *Phys. Rev.* 51. *pp.* 37–47, *Jan.*, 1929.

Absorption spectra have been studied in the region from $0\cdot8$ to $2\cdot5\mu$ with an accuracy of $0\cdot002\mu$ for twenty-four organic liquids, including nine alcohols, six esters, two ethers, two aldehydes, and five miscellaneous compounds. The carbon-hydrogen linkage and other similar ones have been discussed as a probable source of the absorption. While certain inconsistencies are pointed out, no other explanation is available. The relative intensity of the various bands has been discussed, and it is shown that the bands at $1\cdot4$ and $1\cdot0\mu$ and the two bands at $1\cdot2$ and $0\cdot9\mu$ evidently arise from different sources. The effect of homology is shown to be slight, which agrees with the conclusions of Weniger [see Abstract 94 (1911)]. An attempt has been made to get a relation between different band heads of a particular compound. The anharmonic series as suggested by Ellis, and the relation $\nu_n = \nu_0(n)^{1/2}$ suggested by Gapon were both used with moderate success. The latter equation was modified so as to read $\nu_n = \nu_0/(n)^{1/2}$ and applied to part of the data of Weniger with moderate success. AUTHOR.

1872. Absorption of Ultra-Violet Rays by Liquid Carbon Dioxide. G. Harig. *Phys. Zeits.* 30. *pp.* 8–20, *Jan.* 1, 1929.

Gaseous CO_2 shows strong absorption bands in the infra-red, whilst no absorption of visible rays has been found even at high pressure

(50 atmospheres) and in long columns (70m.). Slight absorption in the ultra-violet having been observed by Kreussler and by Schumann, the author made experiments with a Hilger quartz spectrograph and cadmium sparks. The CO_2 was taken from cylinders at 50 atmospheres; higher pressures were obtained by passing the liquid through a steel tube, 50 cm. long, 60 and 78 mm. external and internal diameters, heated by a nickel coil. The absorption tube is a horizontal chromium steel tube closed at both ends by blocks (better cylindrical than conical; the latter cracked more easily) of natural quartz crystal, not fused quartz, which absorbs ultra-violet radiations. The apparatus could bear 1000 kg./cm.^{2} at 500° C. Whilst columns of gaseous CO_2, even 110 cm. long, did not show distinct absorption, columns of the liquid CO_2 (the absorption of which is about 1000 times stronger) absorbed too much for photographic measurements. The final absorption tube was cooled and partly filled with quartz blocks to shorten the column, and a semi-circular plate of quartz was further inserted to determine the quartz absorption by difference. The strong absorption by liquid CO_2 is partly retained above the critical point, but falls off very rapidly. The gas molecules and liquid molecules seem to differ much in absorptive power, but both appear to be able to persist in the supercritical stage. There is a broad band with a maximum absorption at 2265 Å. and a less strong absorption near 2435 Å. H. B.

1873. Infra-Red Emission Spectra of Flames in Nitrous Oxide. C. R. Bailey and K. H. Lih. *Chem. Soc., J. pp.* 51–56, *Jan.*, 1929.

The infra-red emission spectra of coal gas, hydrogen and carbon monoxide, burning in nitrous oxide, were measured. The measurements were made with a Hilger constant deviation spectrometer with a rock-salt prism. The instrument was calibrated by means of the spectra of helium, and the water vapour emission spectrum of the hydrogen flame in air. In the case of CO and coal gas the same spectra were obtained whether the gas was burned by mixing with nitrous oxide, or whether it was burned in an atmosphere of nitrous oxide. When hydrogen was burnt in an atmosphere of nitrous oxide a complex different spectrum was obtained. The production of this new spectrum was attributed to some form of stimulation by the burning hydrogen molecules, since it is absent in the case of coal gas. F. J. B.

1874. Life of Metastable Mercury Atom. M. L. Pool. *Phys. Rev.* 33. *pp.* 22–26, *Jan.*, 1929.

Half-value time for the 2^3P_0 state of Hg for various pressures of admixed N_2.—A high-speed rotating disc has been used to interrupt the total radiation from a water-cooled and magnetically controlled quartz mercury arc before optically exciting mercury vapour in a quartz resonance tube at room-temperature. In the neighbourhood of 10^{-4} sec. after the optical excitation a flash of visible radiation from another water-cooled and magnetically controlled mercury arc was passed through the resonance tube and the absorption spectrum photographed. The line 4047 ($2^3P_0 - 2^3S_1$) showed strong absorption when a few mm. of nitrogen were introduced into the resonance tube. The lines 4077, 4358, 5461, 5770 and 5790 showed no measurable absorption under similar conditions. The rate of decay of the amount of 4047 absorbed with respect to the time-wait after excitation of the mercury vapour was taken as the rate of decay of the metastable 2^3P_0 state. The life or half-value time of the state was found to vary markedly with the pressure of admixed nitrogen. The maximum life $4 \cdot 2 \times 10^{-4}$ sec. occurred for 6·8 mm. of nitrogen. No absorption of 4047 was observed upon the introduction of hydrogen, argon, neon or helium into the resonance tube. AUTHOR.

1875. Structure of the Violet Bands of Silicon Nitride. F. A. Jenkins and H. de Laszlo. *Roy. Soc., Proc.* 22. *pp.* 103–121, *Jan.* 1, 1929.

The violet SiN band spectrum, first investigated by Jevons [see Abstract 1823 (1913)], has now been photographed with a 21-ft. grating using a similar source and the structure of the 10 strongest bands tabulated. Each band has a doublet P and a doublet R branch, and there is one missing line corresponding to a band system of the $^2S \rightarrow {}^2S$ type. Several perturbations are found in the rotational terms, and combinations relations between P and R lines are applied to find the term differences, from which rotational constants are evaluated. The band origins are determined, and the isotope effect is well marked for Si^{28}N, Si^{29}N and Si^{30}N. From this effect in three bands of the strongest sequence quantitative evidence is adduced in support of the quantum mechanics expression for the vibrational energy, which is developed in powers of $(n + \frac{1}{2})$. F. S.

1876. Ground-Terms in the Spectrum of Nickel II. A. C. Menzies. *Roy. Soc., Proc.* 122. *pp.* 134–143, *Jan.* 1, 1929.

The author's fuse-spectrum method is particularly suited to the investigation of ground-terms. The fuse was used horizontally in front of the slit of a vacuum grating spectrograph, and a tendency to form long and short lines was noticed. Many lines, obviously connected on account of their length and strength, were found to belong to the hitherto unknown ground-terms $^2D_3$ and $^2D_2$ of NiII. Since the combining middle terms are accurately known, a number of lines conveniently spaced between 1317 Å. and 1940 Å. can be calculated which can be used as standards. A comparison is made of the author's measurements of lines involving ground-terms of CuII and AgII with those of Lang and White respectively. F. S.

1877. Spectrum of Doubly Ionised Fluorine (F III). H. Dingle. *Roy. Soc., Proc.* 122. *pp.* 144–161, *Jan.* 1, 1929.

The spectrum of doubly ionised fluorine, obtained by passing strong discharges through silicon tetrafluoride, has been isolated and photographed with concave grating and quartz spectrographs. Lines extending from λ3267 to λ2207 have been measured, and 314 are tabulated. The spectrum has been partially analysed into quartet and doublet systems of terms, which have been correlated with those expected on the Heisenberg-Hund theory, and 82 lines have been classified. A comparison with the spectrum of singly ionised oxygen shows a close correspondence, with a few exceptions, which have been discussed. F. S.

1878. Band Systems of the Fluorides of Beryllium and Magnesium. W. Jevons. *Roy. Soc., Proc.* 122. *pp.* 211–227, *Jan.* 1, 1929.

The present observations were made to ascertain whether any further bands might be attributed to BeF and BeO. The description of the newly observed bands is preceded by a discussion of the known systems, in the course of which the data for BeF band-heads are re-examined and a modified interpretation of them suggested; some corrections of, and additions to, the band-head data for the BeO system are also made. The molecule

MgF, dealt with in the latter part of the paper, is one of four 21-electron emitters of known band-systems, *viz.*, SiN, AlO, MgF, and CaH—analogous to four of the above 13-electron emitters. An hitherto unrecorded band-system of MgF is now described. H. H. Ho.

1879. Furnace Spectrum of Beryllium. R. F. Paton and G. M. Rassweiler. *Phys. Rev.* 33. *pp.* 16–21, *Jan.*, 1929.

A high-temperature vacuum furnace using a tungsten container and tungsten heating elements has been designed to study the furnace spectra of substances of high melting points. The furnace spectrum of beryllium in both absorption and emission has been observed from λ2150 Å.–7000 Å. and over a range of temperature up to 2500° K. The prediction that the beryllium line 2348·62 Å. is the first line of the principal series of singlets for the neutral atom has been successfully confirmed, and the diffuse and the sharp series of singlets of this element have been discovered and are tabulated. AUTHORS.

1880. Anomalous *g*-Values in the Spectrum of Ionised Argon (Ar II). C. J. Bakker. *K. Akad. Amsterdam, Proc.* 31. 10. *pp.* 1041–1045, 1928.

Landé's *g*-formula is derived on the basis of the Russell-Saunders coupling scheme, which holds in most spectra. The author has calculated the *g*-values derived from four different coupling schemes, and compares them with those found experimentally in the spectrum of ionised argon. Two tables give the *g*-values observed for the terms of the 4*p* and the 5*s* electrons, and those obtained from each of the four schemes. None of the coupling schemes holds exactly. H. N. A.

1881. Series Spectrum of Arsenic VI. P. Pattabhiramiah and A. S. Rao. *Zeits. f. Physik*, 53. 7–8. *pp.* 587–591, 1929.

A number of lines observed by Sawyer have been classified and tabulated. Singlet and triplet P-, D- and F-terms have been found in accordance with Hund's theory. These terms are compared with those occurring in similar spectra, namely those of NiI, CuII, ZuIII, GaIV and GeV. F. S.

1882. Band Spectra of the Alkaline Earth Halides. Parts I and II. R. C. Johnson. *Roy. Soc., Proc.* 122. *pp.* 161–200, *Jan.* 1, 1929.

In Part I a complete quantum analysis of the whole band spectra of CaF and SrF is made on the basis of a remeasurement of some 250 band heads with a 21-foot Rowland grating. The molecules give rise to at least three band systems which are analogous, the molecules having features common to the one-valence electron type. The band systems are characterised by long sequences in which the members are close together. Only sequences $\Delta n = 0$ and ± 1 occur. There is a characteristic "tail" formation associated with many sequences which is shown to accord with theoretical expectations. The energy of dissociation of CaF is approximately 3·36 volts, and that of SrF of the same order. In Part II the band spectra of BaF and MgF are similarly treated. The bands measured by George [see Abstract 1434 (1913)] are shown to belong to BaF and not to BaO. Suggested transitions of the type $^2D \rightarrow {}^2S$ are discussed, and are believed to be new to band spectra. The bands of MgF constitute a $2^2P \rightarrow 1^2S$ system, in which $\Delta 2^2P = 18 \cdot 6\,\nu$, and there is definite evidence of the vibrational isotope effect in the D_1 sequence. F. S.

1883. Optical Measurements of Small Degrees of Dissociation of Vapours of Metallic Salts. I. Wyneken. *Zeits. f. phys. Chem.* 140. *Abt. A.* 1-2. *pp.* 78-80, *Jan.*, 1929.

This paper is a correction of a previous one on the same subject, in which an incorrect value for the heat of reaction was used [see Abstract 168 (1929)]. The incorrect value was used in the comparison of the experimental and calculated degrees of dissociation, and when the correct value was used, serious discrepancies between the experimental and calculated results were found. The discrepancies were explained by the presence of traces of mercurous chloride. F. J. B.

1884. Secondary Radiations Observed during the Molecular Scattering of Light (Raman Effect). P. Daure. *Comptes Rendus,* 188. *pp.* 61-62, *Jan.* 2, 1929.

The earlier work on the Raman effect [see Abstract 1217 (1929)] has been extended to solutions of metallic and non-metallic halogen derivatives, and to ammonia and methane. The Raman lines for bismuth and antimony chlorides in hydrochloric acid solution are similar. Solutions of the chlorides of magnesium, aluminium and calcium bromide give no Raman lines. The Raman spectra of ammonia consists of a series of broad bands; methane gives one fine line. Liquid oxygen shows no Raman effect. F. J. W.

1885. Scattering of a Standing Electromagnetic Wave. Mildred Allen. *Frank. Inst., J.* 207. *pp.* 19-45, *Jan.*, 1929.

Schrödinger's wave mechanics has been employed to explain the observed scattering of a running electromagnetic wave by an electron (Compton effect). The present paper gives a theoretical treatment of the case of scattering by an electron of a standing electromagnetic wave, which may be regarded as the sum of two running waves in opposite directions. The method used by Gordon [see Abstract 1417 (1927)] for the simpler case is followed closely. The general conclusion drawn is that, to the order of approximation worked with, the scattering by the standing wave is the same as if the two oppositely directed component waves were scattered independently of each other.

W. S. S.

1886. March of the K-Absorption Edge for the Elements. V. Dolejšek and K. Pestrecov. *Comptes Rendus,* 188. *pp.* 164-166, *Jan.* 7, 1929.

New measurements of the K absorption edge for the elements of atomic numbers 26 to 30 are reported. For elements of atomic numbers 12 to 30 the deviations of the experimental values of the edge frequency ν, from the values calculated from the formula $\frac{\nu}{R} = a' + b'N + c'N^2 + d'N^3 + e'N^4$ (coefficients determined from the rare gas frequencies), are found to show a periodic variation with atomic number. W. S. S.

1887. Spark Doublets in the K-Series. V. Dolejšek and Miss D. Engelmannová. *Comptes Rendus,* 188. *pp.* 318-320, *Jan.* 21, 1929.

It has been shown previously that the spark doublets $K\alpha_3$-$K\alpha_4$ and

$K\alpha_5$–$K\alpha_6$ obey the irregular doublet law, the frequency difference being constant and $\Delta\sqrt{\nu/k} = 0{\cdot}007$ for the former doublet. Measurements have been made of this for V, Cr and Mn, and Dauvillier's value for Cu revised. All the values agree with Bäcklin's figure for Si. F. S.

1888. Intensity Ratio in the Wings of Strongly Reversed Multiplets.

W. Bleeker. *Zeits. f. Physik*, 52. 11–12. *pp*. 808–814, 1929.

Shows that in the case of the lines of the sodium doublet ($1s - 2p$), when strongly reversed, the ratio between the intensities in the wings of the two components, at equivalent distances with respect to the broadening of the lines from their respective centres, approaches the theoretical value 2 : 1 when the above distances are increased. This is to be expected, since the self-absorption is largest for the wave-lengths of the centres, and diminished as the distance from them is increased. It was expected that the ratio between the intensities at the centres of the two lines would differ largely from that observed with low-vapour pressure, and this was found to be the case. Similar relations appear to hold for the potassium doublet ($1s - 3p$) and the zinc triplet ($1p - 1s$). In the cæsium doublet ($1s - 3p$) the ratio in the wings was found to be 5·5 : 1; this confirms measurements by Sambursky, who found a ratio of 5 : 1. Curves are given showing how the ratio between the intensities varies at different distances from the centres in different cases. Shows that it is possible, from the experimental results, to calculate the density of the gas which emits the light by means of simple theoretical considerations. H. N. A.

1889. K-Radiation of the Lightest Elements (Al to Be).

M. Söderman. *Zeits. f. Physik*, 52. 11–12. *pp*. 795–807, 1929.

The wave-lengths of the K series of the elements from Al to Be have been determined, using an optical glass grating with 220 lines per millimetre with grazing incidence. The metal X-ray tube employed opened directly into the metal case containing slits, grating and photographic plate, and the whole space was evacuated as in the apparatus of Bäcklin and that of Thibaud. Advantage was taken of a determination of the wave-length of the K_a line of aluminium by Larson to calibrate the vacuum spectrometer, and the following values were obtained for the wave-length of the K_a lines in Å.: Be, 113·4; B, 67·8; C, 44·7; N, 31·77; O, 23·77; F, 18·30; Na, 11·88; Mg, 9·904; Al, 8·323 (Lanson's value) Thibaud's results for B, C, N and O are almost identical. The values are compared with those obtained by other observers, using other methods. The crystal method, using organic substances like the fatty acids with large molecules, does not give very good results above 20 Å.; the method based on measurements of the K and L absorption limits does not seem to be very reliable. The first hydrogen line in the Lyman series, the wave-length of which was determined by Millikan as 1215·7 Å., is due to a passage from the L to the K level, and can be regarded as the K_a line of hydrogen. H. N. A.

1890. Scattering of Radiation by Free Electrons on the New Relativistic Quantum Dynamics of Dirac.

O. Klein and Y. Nishina. *Zeits. f. Physik*, 52. 11–12. *pp*. 853–868, 1929.

The solution of Dirac's wave equations is sought for the case of a free electron in the field of a plane electromagnetic wave. For the intensity of the scattered radiation at a distance r and in a direction making an angle θ with the normal to the primary wave, the following expression is obtained:

$$I = I_0 \frac{e^4}{m^2c^4r^2} \frac{\sin^2\vartheta}{\{1+\alpha(1-\cos\theta)\}^3}\left\{1+\alpha^2\frac{(1-\cos\theta)^2}{2\sin^2\vartheta\{1+\alpha(1-\cos\theta)\}}\right\}$$

where ϑ is the angle between the observation direction and the electric vector in the primary wave and $\alpha = \frac{h}{mc^2}$ {frequency of primary wave}. This result differs from that derived by Dirac and Gordon using the earlier relativistic quantum mechanics, by the presence of the factor $\left\{1+\alpha^2\frac{(1-\cos\theta)^2}{2\sin^2\vartheta\{1+\alpha(1-\cos\theta)\}}\right\}$. This corresponds to a difference of the order $\alpha^2 = \left(\frac{h\nu}{mc^2}\right)^2$, whilst the difference between the quantum theory and classical theory results is of the order α. The new result calls for a modification of the wave-lengths of cosmic rays estimated from the scattering coefficients assuming the Dirac-Gordon result. W. S. S.

1891. Polarisation of the Compton Scattered Radiation on the Dirac Theory of the Electron. Y. Nishina. *Zeits. f. Physik*, 52. 11–12. *pp.* 869–877, 1929.

Continuing a previous paper [see preceding Abstract], the state of polarisation of the light scattered by a free electron (at rest) is investigated, using Dirac's theory of the electron. It appears that for a given initial direction of the magnetic moment of the electron, the radiation scattered from a linearly polarised primary beam can in general be represented by two incoherent elliptically polarised beams, this duality corresponding to the possibility in the theory of the magnetic electron of transitions to two end states. The intensity of the scattered radiation from an elliptically polarised primary wave is also investigated and the results used to determine the intensity of radiation which has been scattered twice at right angles. The latter result would enable a direct experimental test to be made of the state of polarisation of the Compton scattered radiation. W. S. S.

1892. Influence of X-Rays on the Structural Condition of Bismuth and Tellurium. E. Adinolfi. *Accad. Lincei, Atti*, 8. *pp.* 381–388, *Nov.* 11, 1928.

When X-rays are absorbed by Bi during solidification a modification of the structure occurs which is shown by a diminution of the Hall coefficient and also by a change in the thermoelectric behaviour of the metal. Changes in these respects also occur in the case of Te. Experiments are described in this paper which indicate that changes of resistance occur when change of state occurs in Bi, and the behaviour of Bi exposed to X-rays differs from that of ordinary Bi. Moreover, a change occurs in the specific heat of the metals. The specific heat is increased by the action of the X-rays by about 11 % for Bi and 14 % for Bi_x. For Te the increase in the specific heat is 8 % above the normal. A less increase—about 4·3 %—was observed in the case of another specimen of Bi. The values found for Te were more concordant. J. J. S.

1893. Action of Ionising Radiations on Colloids. J. A. Crowther. *Phil. Mag.* 7. *pp.* 86–98, *Jan.*, 1929.

Solutions such as the Bredig solution of copper and ceric hydroxide show a rapid fall in viscosity followed by a rise in viscosity with the ultimate setting of the gel, when they are exposed to X-radiation. The cause of the phenomena was considered to be due to the gradual discharge of the charged colloidal particles by the ionisation produced in the solution by the passage of the rays. It was probable that other ionising agents, such as the β-rays from radium, would produce similar results. A series of experiments were carried out to test this hypothesis. It was found that the effect of X-rays and β-rays was practically the same, and the conclusion was drawn that the change in the colloidal particles was due to the action of the rays on the solvent and not on the particle itself. The problem as to whether the discharge of the solution was the immediate effect of the ionisation or whether the ionisation brought about some chemical change was considered, and on the evidence it seemed probable that the effect was a direct one, and that the colloidal particles have their charges neutralised by the ions formed in the double layer round them. F. J. B.

RADIOACTIVITY.

1894. Quantum Mechanics Explanation of Radioactivity. J. Kudar. *Zeits. f. Physik*, 53. 1–2. *pp*. 61–66, 1929.

Gamow's derivation of the radioactive disintegration constant [see Abstract 532 (1929)] is criticised on the ground that it depends on a mathematically invalid application of the wave mechanics conservation law. It is shown that for the *explanation* of radioactive disintegration, a non-reduced (nicht-selbstadjungiert) form of the wave equation must be employed. W. S. S.

1895. Quantum Mechanics of Radioactivity. J. Kudar. *Zeits. f. Physik*, 53. 1–2. *pp*. 95–99, *and pp*. 134–137, 1929.

The non-relativistic time dependent form of the Schrödinger equation,

$$\frac{\partial\psi}{\partial t} = \frac{h}{4\pi i}\left(\frac{8\pi^2}{h^2}\mathrm{U} - \frac{1}{m}\,\mathrm{div\ grad}\right)\psi$$

is satisfied by

$$\psi = e^{-\lambda t/2 - 2\pi i \mathrm{E}_0 t/h}\,.\,\psi_0(x, y, z).$$

This leads to the time independent equation

$$\mathrm{div\ grad}\,\psi + \frac{8\pi^2 m}{h^2}\left(\mathrm{E} + \frac{ih}{4\pi}\lambda - \mathrm{U}\right)\psi = 0,$$

by means of which a quantum mechanics explanation of α-particle emission is obtainable [see preceding Abstract]. The eigenwert solution of this equation is sought for both one- and three-dimensional cases, U being such that starting from the origin it has the value zero up to a certain distance l_1, then the constant positive value U for a small range l_1 to l_2, and then drops to zero for all greater distances. The principal physical deductions made are as follows: For α-particles in a radioactive nucleus only a finite number of discrete states are possible; the disintegration constant λ is given by

$$\lambda = \frac{32\pi}{h}\mathrm{E}_0^{3/2}\frac{(\mathrm{U} - \mathrm{E}_0)^{3/2}}{\mathrm{U}^2}\,.\,e^{-2(l_2 - l_1)\sqrt{k}\sqrt{\mathrm{U} - \mathrm{E}_0}},$$

$k = \dfrac{8\pi^2 m}{h^2}$ (one-dimensional case); an α-particle with positive energy can be present in the nucleus only if the limiting radius l, at which the Coulomb law ceases to be effective, does not fall below a certain limit. W. S. S.

1896. Wave Mechanics Basis for the Nernst Hypothesis of Reformation of Radioactive Elements. J. Kudar. *Zeits. f. Physik,* 53. 3–4. *pp.* 166–167, 1929.

The author points out that the solution of the Schrödinger wave equation used to explain radioactive disintegration [see preceding Abstract] can be modified to represent the reverse process, reformation, by replacing the diverging waves at the boundary by converging waves. The real eigenwert energy remains unchanged, the sign of λ becoming negative however. Thus, the probability of recombination of the nucleus and an α-particle having the appropriate eigenwert energy is also given by the disintegration constant of the radioactive nucleus formed in such a combination. γ-ray emission is not regarded as directly involved in the α-particle ejection process. It appears possible that transitions of α-particles between different states inside the nucleus may be responsible for γ radiation. W. S. S.

1897. Half-Value Time of Radium D. E. A. W. Schmidt. *Akad. Wiss. Wien, Ber.* 137. 2*a. Nos.* 9–10. *pp.* 647–657, 1928.

By the comparison of the radiation from the successively form radioactive products of a given quantity of radon a new determination of the half-value time of RaD was made. Of the possible methods of determining activity, that of permanent activity and the condensation method were selected and utilised for the given purpose. Possible sources of error are discussed, and the measurement of the preparation was made by three or four different methods. The results show a value of 25 years as the half decay time of RaD. B. J. L.

1898. Penetrating Radiation. J. Clay. *K. Akad. Amsterdam, Proc.* 31. 10. *pp.* 1091–1097, 1928.

Describes further experiments with the two electrometers previously used. Accurate measurements of their capacities were carried out. The value of the primary radiation in Leyden was found to be 1·1I and at Bandoeng 0·76I. Its wave-length is $\lambda = 0 \cdot 28$XU. H. N. A.

1899. Experimental Determination of the Velocity of X-Rays. F. Dacos. *Assoc. Ing. Él. Liège, Bull.* 6. *pp.* 162–190, *Oct.-Nov.*, 1928.

Studies the trajectories of the rays in a transverse alternating magnetic field by means of the Wilson cloud apparatus. The paths are sinuous and have been photographed and measured. It is shown how from the measurements the velocities at different points and the retardations can be calculated. A table and curves show how the velocity diminishes and the retardation increases along the path. The paper concludes with some theoretical considerations. H. N. A.

1900. Counting the Scintillations Produced by α-Particles. Parts I, II and III. J. Chariton and C. A. Lea. *Roy. Soc., Proc.* 122. *pp.* 304–352, *Jan.* 1, 1929.

Part I contains a description of measurements on regular "point" flashes of light of known spectral constitution, in which the minimum radiation visually perceptible was determined. The retinal image of the luminous point observed had about the same dimensions as the retinal cells. The energy is expressed in terms of quanta of green light ($\lambda = 0 \cdot 5\mu$), and the minimum observable was 17 quanta for trained observers and 30 for untrained. For flashes lasting less than 1/100 second the energy only is of importance, and not the duration, for longer flashes the limit approaches the Reeves value of 200 quanta per second. A single case was investigated to determine the effect of a tonic drug on the sensitivity of the eye; it was considerably increased. Part II deals with the radiant and luminous efficiencies of various zinc sulphides bombarded by α-particles, values of about 25 % and 12 % respectively were obtained. Marsden's value for the radiant efficiency was 1·5 %. The high values agree with those obtained by Berndt for luminous paints. In Part III the investigation of the optical system employed on the visibility of scintillations is described, aperture and magnification being varied; the former governs the amount of light entering the eye which affects the number of scintillations observed. The results differ from those of B. Karlik. It was found that when scintillations are observed with the naked eye a scintillation can be observed when it sends out a smaller amount of light, 30 quanta, than is necessary to produce a visual sensation when a microscope is used, *viz.*, 300 quanta; this is partially explained by the difference in size of the retinal images in the two cases. The velocity of the slowest α-particle capable of giving a scintillations was found to be nearly the same as that given by Rutherford. Scintillations observed in certain cases when β-particles fall on a zinc sulphide screen are explained by the simultaneous impact of a number of β-particles on one of the minute crystals of the screen, their actual visibility depending on the amount of non-scintillating luminosity of the screen produced by the remaining β-particles. The authors conclude that the disturbances in the zinc sulphide crystal lattice, which are due to the added impurities and make the crystals emit light when bombarded with α-rays, are spread all through the volume of the crystal, forming a kind of network of slight strains. Some such theory is necessary to explain the high values obtained for the radiant efficiencies of the crystals. H. N. A.

1901. Passage of β-Rays through Matter. C. E. Eddy. *Cambridge Phil. Soc., Proc.* 25. *pp.* 50–61, *Jan.*, 1929.

A Geiger counter was used to measure the proportion of homogeneous β-rays transmitted by different thicknesses of aluminium. The curve transmission-thickness was found to be linear except for an initial flattening (also observed for copper and silver but not for gold). Experiments were also carried out on the range of β-rays emergent at different angles and on the angular distribution of plurally scattered particles, the existence of a most probable angle of scattering being indicated. W. S. S.

1902. Measurement of the Active Deposit of Radium by Penetrating γ-Rays. Irène Curie. *Comptes Rendus*, 188. *pp.* 64–66, *Jan.* 2, 1929.

Experimental examination of the necessary correction for the effect of the γ-rays of radium B, in measurements of quantities of radium C by the γ-ray electroscope, under different experimental conditions. The magnitude of the correction is evaluated for the experimental results of the author and Joliot [see Abstract 196 (1929)], where it is found to be practically negligible. H. R. R.

HEAT.

1903. Thermal Conductivity of Solid and Liquid Sulphur. G. W. C. Kaye and W. F. Higgins. *Roy. Soc., Proc.* **122.** *pp.* **633–646,** *Feb.* **4, 1929.**

The thermal conductivity of solid and liquid sulphur was determined by a " plate " method on which a thin horizontal layer of the material was sandwiched between a hot and cold metal block, between which a small difference of temperature was maintained. The hot block was the upper one in the arrangement. The measurements were carried out over a range of temperature of from 20° to 210° C. The temperature range includes the transition point from rhombic to monoclinic sulphur, 95° C., the natural melting point of monoclinic sulphur, 115° C., and the change point of liquid sulphur, 160° C. Some measurements were also made on the plastic modification. The results show the effect of the previous thermal history on the rates of the several transformations. F. J. B.

1904. Triple Point of Water as Fixed Point of the Temperature Scale. H. Moser. *Ann. d. Physik,* **1. 3.** *pp.* **341–360,** *Feb.* **9, 1929.**

The paper is a record of a particularly careful method of determination of the triple point of water. By special attention to the purity of the water, and by means of a particularly delicate method of temperature measurement, the temperature constant at the triple point of water is established within an accuracy of $\pm 0{\cdot}5^\circ \times 10^{-40}$ C. This point can, therefore, be used as a fixed point on the temperature scale. The lowering of the melting point with pressure increase from 0 to 1 atmosphere was determined experimentally with accuracy, and was found to be in good agreement with the values calculated from the Clausius-Clapeyron formula. Experimental details and results are fully described. S. G. B.

1905. Platinum Thermometer Temperature Scale. F. E. Hoare. *Phil. Mag.* **7.** *pp.* **384–386,** *Feb.,* **1929.**

Describes an arithmetical device for obtaining temperatures from platinum thermometer readings with the minimum amount of calculation. E. G.

1906. Majorana Thermal Effect. A. L. T. Moesveld. *Zeits. f. phys. Chem.* **140.** *Abt. A. pp.* **423–428,** *Feb.,* **1929.**

Q. Majorana found that for a long time a temperature difference persists between two masses of metal exposed to the same temperature, when one of the masses has first been heated. It seems very improbable that M. A. Schirmann [see Abstract 211 (1929)] is correct in assuming this effect to be due to adsorption of gas. Both qualitatively and quantitatively the effect is explained by Ernst Cohen's observations on the metastability and the slow stabilising of elements and compounds. A. D.

1907. Specific Heat of Manganese Phosphide. B. G. Whitmore. *Phil. Mag.* **7.** *pp.* **125–129,** *Jan.,* **1929.**

On Weiss' theory of ferromagnetism an additional term appears in the specific heat of a ferromagnetic body in the region of its magnetic critical temperature owing to the loss of magnetic potential energy. This term is given by the expression $\frac{1}{2J} \cdot \frac{N}{\rho} \cdot \frac{dI^2}{dT}$, where N is the constant of the Weiss internal field and ρ is the density of the material. In the case of iron, nickel, cobalt and magnetite the specific heat has been found to vary in accordance with the theory of Weiss. Bates' recent experiments on a substance consisting of equal parts of manganese and arsenic left doubtful the exact cause of the large changes in the specific heat in the neighbourhood of the magnetic critical point. The experiments described in the present paper were made on a material consisting of equal parts of Mn and P. The measurements carried out on the variation of the specific heat of this ferromagnetic material, in the neighbourhood of its magnetic critical temperature, have left it uncertain whether the maximum value of the specific heat coincided with the maximum value of $I \cdot \partial I/\partial T$, or with that of $\partial I/\partial T$, but a small increase in specific heat of the order expected on Weiss' theory was observed near the temperature at which the value of $I \cdot \partial I/\partial T$ was a maximum. J. J. S.

1908. Calorimetric Researches. Part II. Heat of Combustion of a Proposed Secondary Calorimetric Standard: Salicylic Acid. L. J. P. Keffler. *J. Phys. Chem.* 33. *pp.* 37–51, *Jan.*, 1929.

The history of the proposal to use salicylic acid as a secondary calorimetric standard is reviewed. A careful redetermination of the heat of combustion of salicylic acid was made in a Moureu bomb. As a means of 19 determinations the heat of combustion was found to be 5234·8 cal. per gramme weighed *in vacuo*. The salicylic acid employed in the determinations was carefully purified. The errors of the various measurements were discussed, and the most probable value for the heat of combustion of salicylic acid was taken as 5235 ± 1 cal. per gramme weighed *in vacuo*.

F. J. B.

1909. Heats of Solution of some Salts in Water and Ethyl Alcohol Solutions. J. R. Partington and W. E. Soper. *Phil. Mag.* 7. *pp.* 209–247, *Feb.*, 1929.

The importance of solutions of electrolytes in non-aqueous media, and the lack of data on this subject, led the authors to make an investigation of the heats of solution of a number of salts in water at each end of the concentration range. A specially accurate calorimetric method was devised, and the instrument was calibrated electrically. The heats of solution and dilution of KCl in water, KCNS in water, NaCNS in ethyl alcohol, anhydrous cupric chloride in water, calcium nitrate in both water and alcohol. The results were compared with those recorded in the literature and critically discussed. F. J. B.

1910. Heat Capacities in Aqueous Salt Solutions. M. Randall and F. D. Rossini. *Am. Chem. Soc., J.* 51. *pp.* 323–345, *Feb.*, 1929.

The following symbols are used: *m*, number of moles of solute per 1000 gm. (55·508 moles) of water *in vacuo*: C_p, heat capacity of that amount of solution which contains 1000 gm. of water plus *m* moles of solute; $\bar{C}_{p_2}$, partial molal heat capacity of the solute which is dC_p/dm and represents the change in the heat capacity of a very large amount of solution on the addition of 1 mole of solute. If the capacity of the 1000 gm. of water is G cal., then on addition of a single mole of NaCl the capacity will be G − *a*, where *a* is the capacity of one sodium ion plus one chloride ion. The apparent molal heat capacity of the solute is ϕ°, the ° standing for infinite dilution. Experiments are made with a unit calorimeter of the Randall-Ramage type, which is described. The multiple thermal junctions are contained in a pyrex glass tube surrounded by a cooling coil and a heating coil, the latter consisting of a fine silver tube drawn over silk-insulated manganin wire with a coating of bakelite. The ϕ, $\bar{C}_{p_2}$, $\bar{C}_{p_1}$ and specific heats are determined of anhydrous salts, nitrates, sulphates and halides of sodium and potassium in aqueous solutions from infinite to 1·0 or 2·5 molal. A theoretical equation is deduced for $C_{p,\,p_2} - C^0_{p_2}$ on the Debye-Hückel theory of strong electrolytes. The partial molal heat capacity of an ion is shown to depend upon the charge size and configuration of the ion, and those capacities are found to be additive for ions at infinite dilution. H. B.

1911. Heats of Dilution of Sodium Hydroxide, Acetic Acid and Sodium Acetate, and their Bearing on Heat Capacities and Heats of Neutralisation. T. W. Richards and F. T. Gucker, Jr. *Am. Chem. Soc., J.* 51. *pp.* 712–727, *March,* 1929.

New data at 16° and 20° are presented, these being necessary for computing the heats of neutralisation involved at various concentrations. The apparatus [see Abstract 93 (1921)] has been improved and all temperature measurements are made by a platinum resistance thermometer. Errors and corrections have been comprehensively studied. It has been found that although all the other heats of neutralisation investigated in this way decrease as the concentration of the reagents is diminished, that for acetic acid (which is distinctly less than those of stronger acids) increases as the solutions become more dilute. Apparently, however, they tend toward the same value at infinite dilution, about 13·6 cal. (or 56·8 kilojoules), which would appear to be the most probable value for the heat of the reaction $H^+ + OH^- = H_2O$. H. H. Ho.

1912. Melting Curve of Hydrogen up to a Pressure of 245 kg/cm². W. van Gulik and W. H. Keesom. *R. Akad. Amsterdam, Proc.* 31. 10. *pp.* 1059–1060, 1928. *Comm. No.* 192*b from the Phys. Lab., Leiden.*

The paper gives an account of a "first continuation" of an investigation on the melting curve of hydrogen [see Abstract 1450 (1927)]. The apparatus is the same as that described by W. H. Keesom [see Abstract 1061 (1927)]. The results can be well combined with the previous ones, and are shown in a smooth curve and in the table below:

Temperature K°.	Pressure.	
	Kg./cm.².	Atmosphere.
20·34	245	237
19·69	215	208
18·36	161	155
17·27	114	110
16·31	97	94

T. B.

1913. Boiling-Point Apparatus for High Pressures. W. Swietoslawski. *Comptes Rendus,* 188. *pp.* 392–395, *Jan.* 28, 1929.

The glass portion of the apparatus, in which the liquid is boiled by means of an electrically heated resistance coil, is contained in a cylindrical steel vessel, to which a steel cover is bolted. The condenser tube passes through this cover and vertically upward through a copper tube, which connects the steel vessel to a compressed nitrogen reservoir. The temperature of the vapour is measured by means of an electrical resistance thermometer. Two of these ebullioscopes are used simultaneously and connected with the same nitrogen reservoir, one containing water and the other the liquid experimented with, the second is generally of the author's differential type. The pressure can be determined by measuring the temperature at which the water boils, or by determining the quantity of nitrogen contained in a tube provided with taps at the ends, and communicating with the compressed nitrogen reservoir. [See next Abstract.] H. N. A.

1914. Modification of Swietoslawski's Boiling-Point Apparatus for High Pressures. A. Zmaczynski. *Comptes Rendus*, 188. *pp*. 395–396, *Jan*. 28, 1929.

It is necessary that the liquid when heated to the boiling point should fill the bulb completely and rise to a definite point in the tube leading upward from it. If the pressure alters much the volume of liquid in the bulb is no longer correct, and the author has added a syphon arrangement, which automatically adjusts the amount of liquid to the correct value for all pressures. [See preceding Abstract.] H. N. A.

1915. New Application of the Differential Ebullioscope. H. Swietoslawski. *Comptes Rendus*, 188. *pp*. 256–258, *Jan*. 14, 1929.

The author's differential ebullioscope (Bull. Soc. Chim. (4) 41. pp. 717–720, 1927) distinguishes between pure liquids and azeotropic mixtures when used under varying pressures. For a pure liquid the P–T curves for $P-T_H$ and $P-T_B$ coincide for all pressures, for mixtures they do not, save only at the pressure for which the particular mixture under examination is azeotropic. The case of alcohol-benzene mixtures is dealt with in detail. C. A. S.

1916. Still for Liquids of High Boiling Point. K. Hickman. *Kodak Research Lab. Comm. No*. 368. *J.O.S.A. and R.S.I.* 18. *pp*. 69–71, *Jan*., 1929.

Particulars are given of the construction of a distillation apparatus of pyrex glass shaped to form an alembic and which can be electrically heated. The apparatus is first connected to a vacuum pump for 10 to 15 minutes to remove dissolved air and so avoid bumping of the liquid. When bubbling ceases the liquid is heated and the distillate collected. If used carefully there is no danger of contaminating the pump oil. R. S. R.

1917. Cooling of a Bar. S. L. Straneo. *Accad. Lincei, Atti*, 8. *pp*. 575–579, *Dec*. 2, 1928.

Previously the author has given a study of the propagation of heat in a semi-infinite bar by an application of the functional method. In this note he applies the same method to the study of the propagation of heat in a bar or other system in which an arbitrary distribution of temperature is assumed at the time $t = 0$. J. J. S.

1918. Effect of Corona Current on the Cooling of a Hot Wire. S. R. Parsons. *Univ. of Arkansas, Research Paper, No*. 105. *Phys. Rev*. 33. *pp*. 75–80, *Jan*., 1929.

This article describes an experimental study of the cooling of a hot wire in air, when the air is disturbed by a corona discharge to the wire. With a copper wire, No. 30 B. & S. gauge, *in still air*, no effect was found with a corona current less than 3 micro-amperes per cm. of wire; but beginning with about that value, the cooling power of the wire increases, at first rapidly, and then more slowly, possibly passing through a poorly defined maximum. A corona current as great as 12 micro-amperes per cm. is sufficient to give nearly the maximum effect. With small currents of air past the wire, a gradual increase of the corona current, starting with zero, often shows first a heating effect, followed by a cooling effect. The slow currents of air seem to be appreciably retarded by the cross-flow of the ions carrying the corona current. The number of ions required for appreciable cooling is estimated to be considerably less than one ion per million molecules of the gas. AUTHOR.

1919. Rayleigh-Jeans Law of Radiation. K. C. Kar and R. C. Mazumdar. *Zeits. f. Physik*, 53. 3–4. *pp.* 308–311, 1929.

The method employed in a previous paper [see Abstract 1283 (1923)] is utilised to deduce the Rayleigh-Jeans law of distribution of radiation from sources in either translatory or rotatory motion. J. S. G. T.

1920. Radiometer Effect with Thin Plates between Plates at Different Temperatures in Gases at High Pressures. P. Schmudde. *Zeits. f. Physik*, 53. 5–6. *pp.* 331–366, 1929.

The first part of the paper gives a brief summary of work done on the radiometer effect, beginning with that of Knudsen [see Abstract 1180 (1910)], whose work was extended by Debye. Hettner made a considerable advance on previous work and stated the law of thermal slipping. When along the surface of contact of a gas and a solid body a temperature gradient exists, the gas moves in streams from places of lower to places of higher temperature. The combination of this law with Knudsen's theory by means of Hettner's interpolation formula yields results in accord with experiment as far as the uncertainty of the temperature distribution on the fixed plates permits. The object of the author's work was to investigate the radiometer effect on thin plates at high pressures under better defined experimental conditions than had been employed previously. With this object in view the plate was placed in a homogeneous heat current which passed between two parallel plates at different temperatures. This removed the necessity for blackening the plates. The homogeneity of the heat stream was examined and its gradient carefully measured. Hettner's theory can only give qualitative results for this case, but Einstein has given a theory which is largely independent of the properties of the edge surface, and which deals with the radiometer effect in a homogeneous hot stream. A statement of Einstein's law is then given, with the conditions under which it can be applied. A diagram and detailed description of the author's apparatus follows. The remaining 27 pages give the results obtained together with a number of curves. A comparison of results with Einstein's theory is made. An explanation is offered of the surface and edge effects. The effect of the variation of the distance between the fixed plates and of the movable plate from the fixed plates at constant gas pressure is investigated. Several shapes and sizes of movable plates are employed. T. B.

1921. Condition for the Equilibrium of a Liquid with its Vapour given by Boltzmann, and the Relation between this Condition and

the Thermodynamic Potential. J. W. Dekker. *K. Akad. Amsterdam, Proc.* 31. 9. *pp.* 973–977, 1928.

In his "Gastheorie," Boltzmann gives, for the equilibrium between liquid and vapour of a simple substance, a condition which resolves itself into the identity of the value of $v_b \, . \, e^{-\epsilon_{\text{mol.}}/k\text{T}}$ in the two phases; v_b is, per gramme-molecule, the space available for a last molecule centre amidst the other molecules already present, $\epsilon_{\text{mol.}}$ the potential energy of one molecule in relation to the others, and $k\text{T}$ double the mean kinetic energy per degree of freedom. Since, when n represents the number of molecules per gramme-molecule, $n\epsilon_{\text{mol.}} = 2\epsilon_{\text{pot.}}$, *i.e.*, twice the potential energy per gramme-molecule and $nk\text{T} = \text{RT}$, it follows, according to the above condition, that $2\epsilon_{\text{pot.}} - \text{RT} \log v_b$ must have the same value in the two phases. It is now shown, firstly following Boltzmann's reasoning, and secondly by means of Gibbs' statistical method, that in general this expression is not quite correct, and that $\epsilon_{\text{pot.}} - \frac{\partial \epsilon_{\text{pot.}}}{\partial v} \cdot v - \text{RT} \log v_b$ should be substituted for it. The two expressions are in conformity only when $\epsilon_{\text{pot.}} = \frac{a}{v}$. T. H. P.

1922. Approximate Prediction of Vapour Pressure. J. Chipman. *J. Phys. Chem.* 33. *pp.* 131–135, *Jan.*, 1929.

Relationships between ΔH (heat of vaporisation), L' (apparent heat of vaporisation from vapour pressure data) and ΔH_k (heat of vaporisation by the Kistiakowsky equation) have been investigated. The author had previously shown [see Abstract 548 (1929)] that the Kistiakowsky equation was the most reliable, and he now establishes that for a given class of liquids the ratio between any two of the above quantities at the boiling point is approximately constant. The ratio, $\text{L}'/\Delta\text{H}_k = g$, called the "slope factor," may be estimated for nearly any liquid by comparison with the tables given. This factor and the normal boiling point are sufficient to establish the approximate vapour pressure equation. A simple and reliable method of correcting observed boiling points to normal pressure is presented. H. H. Ho.

1923. Pressures of Gaseous Mixtures. Part II. Helium and Hydrogen and their Intermolecular Forces. C. W. Gibby, C. C. Tanner and I. Masson. *Roy. Soc., Proc.* 122. *pp.* 283–304, *Jan.* 1, 1929.

The compressibilities of helium, hydrogen and ten mixtures of the two have been measured at 25° C. up to 125 atmospheres, and those of the pure gases and an equimolecular mixture at seven temperatures from 25° to 175° C. Deviations from Dalton's law are positive, and are at a maximum in the equimolecular mixture. Certain mixtures are more incompressible than hydrogen. The equation $pv = a + bp$ holds for each mixture; the values of a and b for each mixture and each temperature are recorded. The results are studied in the light of Lennard-Jones' analysis of intermolecular forces; for encounters between atoms between H_2 molecules and between He and H_2, using a distance index of -5 for the attractive force component, the index for the repulsive component is found to be -10 or -11 in all three cases; these values are compared with those calculated by Lennard-Jones from the data of other workers. The force constants for an encounter of He with H_2 are considerably nearer to those for He with He than to those for H_2 with H_2. The energy factors are calculated for each case; the cohesion energy is defined and tabulated, together with the kinetic diameters for different temperatures; the intermolecular distances of closest contact between He and H_2 approximate to the sum of the two kinetic half-diameters. H. N. A.

1924. Quantum Theory of an Ideal Gas and Avogadro's Law. G. Polvani. *N. Cimento*, 5. *pp.* 307–309, *Aug.–Sept.–Oct.*, 1928.

From the kinetic theory of gases founded on the classical principles of Maxwell and Boltzmann two ideal monatomic gases at the same temperature and pressure and occupying equal volumes contain the same number of molecules. Fermi, in his recent theory of the ideal monatomic gas, has shown that the classical theory of Maxwell and Boltzmann must be considered as the limiting case of a more general theory founded on the principles of quanta, this limiting case being attained when the temperature and the rarefaction approach infinity—practically when they are very high. The deviations from the law of Avogadro shown by an ideal monatomic gas in a state of great degeneration are considered in the present paper. If two different gases at infinitely low temperatures occupy equal volumes, their masses being m_1 and m_2, and N_1 and N_2 the numbers of the molecules in the respective gases, then in the case of the strongest degeneration, neglecting quantities of the second order, $\frac{N_1}{N_2} = \left(\frac{m_1}{m_2}\right)^{3/5}$, *i.e.*, if two ideal monatomic gases occupy equal volumes under equal pressures and their temperatures are infinitely low, the numbers of the molecules constituting the two gases are to each other as the $\frac{3}{5}$-power of their molecular weights. J. J. S.

1925. Simple Method for Determining C_p/C_v. E. Rüchardt. *Phys. Zeits.* 30. *pp.* 58–59, *Jan.* 15, 1929.

A lecture-room apparatus, which takes advantage of the fact that glass tubes and steel balls can now be obtained in the market the shapes and dimensions of which are of such precision that the ball slides almost air-tight in the tube. The tube is mounted vertically in a hole in the rubber stopper of a glass bottle, and when the steel ball is introduced at the top of the tube it falls and compresses the gas contained in the bottle, which drives it up again, so that it oscillates up and down as many as ten times before it comes to rest. The author shows how, from the time of oscillation and the different constants of the apparatus, it is possible to calculate the value of C_p/C_v for the gas. H. N. A.

1926. Adiabatic Expansion in the Case of Vanishing Increments. C. Barus. *Nat. Acad. Sci., Proc.* 15. *pp.* 22–25, *Jan.*, 1929.

This investigation deals with the reduction of measurements in the adiabatic expansion of gases to a ratio of successive micrometer shifts of the U-gauge interferometer. T. H. P.

1927. Properties of Substances and Mixtures at the Absolute Zero of Temperature. R. D. Kleeman. *J. Phys. Chem.* 32. *pp.* 1841–1855, *Dec.*, 1928.

The author has previously shown that the controllable internal energy and the controllable entropy are each zero for a substance or mixture in the condensed state under its vapour pressure at the absolute zero of temperature. The entropy is also zero for all other states at the absolute zero. In the present paper some of the results obtained are extended, and consideration is given to the following: (1) Properties of the heat and external work of evaporation at the absolute zero. (2) Properties of the condensed state at the absolute zero. (3) The form of the equation of state of the vapour of a substance at or near the absolute zero. (4) The temperature coefficient of the pressure of the saturated vapour of a substance or mixture at $T = 0$. (5) Properties of the heat and work of mixing of substances in the gaseous state at the absolute zero. (6) Properties of the change in free energy and the heat of formation of substances in the gaseous state at absolute zero. (7) Properties of the internal specific heat of a vapour in contact with the condensed state. (8) The heat of formation of molecules in the gaseous state at infinite volume at a finite temperature. (9) The fact that the temperature of a substance cannot be reduced to the absolute zero in a finite time. (10) The theorem that the controllable entropy is positive and can be infinite only when the temperature is infinite. The treatment is mathematical throughout. It appears hardly likely that there is matter in the universe whose temperature is at the absolute zero unless it began that way. But since radiation of the heavenly bodies into space has been going on for millions of years the temperature of some of them must be close to the absolute zero. Since some substances may become unstable under these conditions, some interesting astronomical possibilities are opened up. J. J. S.

1928. Change that a Gaseous Molecule may Undergo between two Consecutive Collisions. R. D. Kleeman. *Phil. Mag.* 7. *pp.* 53–63, *Jan.*, 1929.

In a previous paper [see Abstract 2778 (1928)] the equation of a perfect gas is shown to be $pv = \xi MRT$, where ξ is a function of T, v, and M. The physical significance of ξ is now investigated. In §2 it is shown that ξ decreases as v increases; §3 considers the change in the velocity of a molecule in a gas between two consecutive collisions; §4 deals with the effect of heat radiation on the molecular velocity of translation; §5 deduces the above equation by an alternative method; §6 discusses experimental methods of investigating the nature of ξ, while §7 is devoted to miscellaneous deductions; §8 gives applications to an electron gas, and §9 to Carnot's cycle. H. H. HO.

1929. Carnot's Principle: Theorem. Formulæ of the Second Law of Thermodynamics Independent of any Principle. C. Raveau. *Comptes Rendus,* 188. *pp.* 313–316, *Jan.* 21, 1929.

The work produced in a Carnot's cycle with limits t, t' and absorbing Q calories at t has a superior limit $JQ(T - T')/T \geq W$, the coefficient of Q having the sign + or − of $(t - t')$. The author discusses, historically, which of the enunciations of the second principle is expressed by this inequality, and, on the other hand, if all the relations which it is possible mathematically to draw from it, for a complete cycle, and for simple cycles, are really the logical consequences of it. In the celebrated theorem of Carnot it is necessary to distinguish the implicit condition of maximum efficiency which can be deduced from the principle, and the affirmation of thermodynamical similitude which is rightly based on something else. Clausius was wrong in trying to deduce from its inequality a condition of equality, which would have resulted just as well from the opposite inequality. T. B.

1930. Clapeyron's Cycle. L. Lecornu. *Comptes Rendus*, 188. *pp*. 209–212, *Jan*. 14, 1929.

Carnot's cycle in the entropy diagram (s, t) is represented by a rectangle with its sides parallel to the axes. This cycle is the one which between two given temperatures gives the highest possible efficiency. Clapeyron's diagram (v, p) also gives, in its simplest form, a rectangle with sides parallel to the axes. Its efficiency as a function of the extreme temperatures is inferior to that of Carnot, but it gives the maximum of work for the given limits of volume and pressure. The thermal properties of Clapeyron's cycle are discussed, the discussion being limited to the case of a perfect gas $(pv = \mathrm{R}t)$. It is remarked that with the cycle of Carnot with two sources at temperatures t_1 and t_2 there is no limit to the amount of work obtainable, since the quantities of heat q_1 and q_2 may be increased indefinitely under the sole condition that they remain proportional to t_1 and t_2. With the cycle of Clapeyron on the contrary (where the employment of intermediate sources of heat is assumed), the quantities of heat must be comprised between $c(t_1 - t_2)$ and $\mathrm{C}(t_1 - t_2)$, where c and C are the specific heats at constant volume and constant pressure respectively. T. B.

1931. Clapeyron's Cycle in the case of a Saturated Vapour. L. Lecornu. *Comptes Rendus*, 188. *pp*. 521–523, *Feb*. 18, 1929.

In a previous note [see preceding Abstract] the properties of the cycle of Clapeyron have been studied for the case of a perfect gas. A similar examination for the case of saturated vapours $(p = f(t))$ is made in the present paper. It is shown that the efficiency of the cycle is always inferior to $\mathrm{T}/(\mathrm{E}c_0(t_1 - t_2))$, where E is the mechanical equivalent of heat, T the work obtained (equal to the area of the cycle), c_0 the specific heat of the liquid. It was shown in the former note that for a perfect gas the efficiency was superior to $\mathrm{T}/(\mathrm{EC}(t_1 - t_2))$, where C is the specific heat at constant pressure. As c_0 is greater than C, it is clear that the efficiency of the cycle with saturated vapour can never attain that of the cycle with vapour strongly superheated, the latter case approximating to that of a perfect gas. In fact, the efficiency gradually increases as the vapour becomes more and more superheated. This change is not surprising when we bear in mind the profound difference which exists between the properties of saturated and of superheated vapours. T. B.

1932. Equations of State and Thermodynamics. V. Karpen. *Comptes Rendus*, 188. *pp*. 496–498, *Feb*. 11, 1929.

The author in a former note showed that $d\mathrm{Q}/\mathrm{T}$ is an exact differential, *i.e.*, the single-phase fluid satisfies Carnot's principle, and he derived the Maxwell-Clausius relation and the Clapeyron equation for the heat of vaporisation of a fluid. Verschaffelt raised objections to these conclusions. The author, in replying, states that he is quoted incorrectly regarding (1) the establishment of van der Waals' equation and (2) all the consequences of Carnot's principle following from the fact of $d\mathrm{Q}/\mathrm{T}$ being an exact differential for a simple transformation of the fluid of single phase. R. S. R.

1933. Van der Waals' Equation and Thermodynamics. J. E. Verschaffelt. *Comptes Rendus*, 188. *pp*. 312–313, *Jan*. 21, 1929.

Under the above title, V. Karpen [see Abstract 1608 (1929)] proposed to demonstrate that the fluid theories conforming to the hypotheses which have served as bases for the establishment of the characteristic equation of van der Waals obey the principles of thermodynamics, and in particular that the Maxwell-Clausius relation and Clapeyron's formula can be deduced from this equation without the invocation of the second principle (of thermodynamics). Every equation of state can be reconciled with the second principle, provided one adds to it under the form of an added hypothesis, not contained in the equation of state itself, a condition which is compatible with the second principle and is equivalent to it. This condition may be, for example, a hypothesis relating to the internal energy (Joule's law for example). In the case of van der Waals' equation, it will be sufficient to suppose that $dU = c_v dT + p'dv$, where c_v is a unique function of the temperature, and p' is the pressure of cohesion ($p' = a/v^2$). T. B.

1934. New Equation of State. H. J. Brennen. *Nat. Acad. Sci., Proc.* 15. *pp.* 11–18, *Jan.*, 1929.

Expansion and rearrangement of the van der Waals equation of state leads to an equation of the third degree in V and thus has three roots, which may reasonably be assumed to be equal at the critical point. This supposition imposes three conditions on the equation, which must contain three parameters. It is shown, however, that the equations contains only two parameters, a and b, and must in general be mathematically absurd. Change of the term due to the cohesive pressure of the molecules from $\frac{a}{V^2}$ to $\frac{a}{V^n}$ is suggested, giving $\left(P + \frac{a}{V^n}\right)(V - b) = RT$, or $\left(P_r + \frac{a_r}{V_r^n}\right)(V_r - b_r) = KT_r$, where $P = P_r P_c$, $T = T_r T_c$, $V = V_r V_c$, $a = a_r P_c V_c^n$, $b = b_r V_c$, and $K = \frac{RT_c}{P_c V_c}$, P_c, T_c and V_c denoting the pressure, temperature and volume at the critical point. Solution of this equation by calculus methods shows that $K = \frac{1 - b_r^2}{b_r} = \frac{a_r^2 - 1}{a_r} = \frac{4n}{n^2 - 1}$. Hence a_r, b_r and n are not only interconnected by a very simple relationships, but are definite, single-valued functions of the critical ratio K, which thus becomes of fundamental importance in the theory of equations of state and should be redetermined as accurately as possible for a large number of substances. If K be made equal to $\frac{8}{3}$, a_r, b_r and n become 3, $\frac{1}{3}$ and 2, which is the van der Waals equation; if K be put equal to $\frac{15}{4}$, the values of the constants become 4, $\frac{1}{4}$ and $\frac{5}{3}$, which is Dieterici's equation. Thus, these two equations are only particular cases of the more general one given above. This generalisation of the van der Waals equation is supported not only by the mathematical requirement of a third parameter, but also by the fact that the cohesive forces between the molecules, formerly regarded as gravitational, are almost certainly of electrical origin. T. H. P.

SOUND.

1935. Vowels. E. W. Scripture. *Phys. Zeits.* 29. *pp.* 911–912, *Dec.* 1, 1928. *Paper read before the Deut. Naturforscher. u. Ärzte, Hamburg, Sept.*, 1928.

A short summary of the results of the work on the physical nature of vowels as revealed by the study of gramophone records and oscillograms. W. H. Ge.

1936. Heart Sounds and Noises. K. Posener and F. Trendelenburg. *Zeits. f. techn. Physik,* 9. 12. *pp.* 495–499, 1928. *Paper read before the Deut. Naturforscher u. Ärzte, Hamburg, Sept.*, 1928.

The first heart sound arises through the closing of the ventricular valve, whilst the second coincides with the closing of the semilunar valve. Besides these there are heart noises which become more prominent if the valves become constricted or hardened or do not shut properly. The frequencies vary from the audible limit to 100 in the heart sounds, and certain components of the noises have frequencies round about 1000. The sound phenomena were investigated by means of a condenser-microphone, which was applied to the breast like a stethoscope. Various records of heart sounds and noises are illustrated and discussed. G. E. A.

1937. Acoustic Impedance. P. Drumaux. *Ann. Soc. Sci. de Bruxelles,* 48. *pp.* 92–98, *Dec.*, 1928.

A simple proof of the formula $V = 1/\sqrt{\beta\rho}$ is supplied, where β, the compressibility, takes the place of the elastic constant in the well-known formula for the velocity of sound. Hence it is shown that the instantaneous speed at any section of the cylindrical portion of the medium considered is given by $v = \frac{\delta p}{\sqrt{\frac{\rho}{\beta}}}$, where δp is the change of pressure applied. The quantity $\sqrt{\rho/\beta}$ is defined as the impedance Z of the medium. The cylindrical medium is then supposed to be made up of two parts with impedances Z_1 and Z_2, and it is shown that an initial pressure-disturbance gives rise to a reflected wave for which the coefficient of reflection K is $(Z_1 - Z_2)/(Z_1 + Z_2)$, and the coefficient of transmission is $1 - K$. The laws of propagation, reflection and refraction of sound may thus be derived without reference to the usual differential equations. G. E. A.

1938. Condenser Telephone. G. Green. *Phil. Mag.* 7. *pp.* 115–125, *Jan.*, 1929.

In a former paper [see Abstract 416 (1927)] the author discussed the mathematical theory of the condenser telephone in a preliminary way, a special case only being considered, that of a condenser of two plates only separated by a dielectric sheet of elastic material, one plate being fixed, the other free to move in response to electrical vibrations transmitted to the condenser circuit. In the present paper the author discusses the more important case (from a practical point of view) of a condenser consisting of a pile of plates of which only one is fixed, the others being free to move in response to electrical vibrations. This more general case is interesting in itself, and explains more fully the dynamical theory of the condenser telephone. The equations reached in the mathematical investigation are similar to those representing the disturbed motion of a series of masses, each mass being suspended from the mass preceding it in the series by a vertical spring, and the uppermost mass being similarly suspended from a fixed support. This system corresponds exactly with the condenser-telephone system if it is supposed that the masses are all equal and that the springs are also all equal, and that the lowest or *n*th mass is operated on by forces represented by three terms occurring in the author's equations for the electrical case, in addition to the force applied to it by the spring connecting it to the mass above it. These forces consist of a frictional resistance proportional to the velocity, a restoring force proportional to the displacement, and a disturbing periodic force. The motion of the condenser plates may, therefore, be identified with that of a dynamical system whose general characteristics have been fully investigated elsewhere. J. J. S.

1939. Sound Pressure on Air Resonators. E. Waetzmann and K. Schuster. *Ann. d. Physik,* 1. 4. *pp.* 556–564, *Feb.* 25, 1929.

The force exerted on a resonator by sound waves has been the subject of theoretical investigation [see Abstract 2738 (1927)]. It is composed of at least three parts, one a force of attraction, independent of the tone of the resonator. A second part is the phase force; below resonance, the resonator is attracted, and with frequencies greater than that of resonance the resonator is repelled. The third part is the resonance force and causes repulsion for all frequencies, being a maximum at the resonance frequency. These conclusions are verified by means of experiments in which a resonator, carried on the arm of a torsion balance, is acted on by waves from a rubber membrane coupled by an air column to a telephone membrane. The amplitude of the latter is kept constant, and the force on the resonator is measured in terms of the torsion by lamp and scale. The graph of force and frequency is obtained, and is analysed into the three components stated above. Maximum attraction is separated from maximum repulsion by a very small range of frequency. G. E. A.

1940. Duration of Impact of Struck String. D. Banerji and R. Ganguli. *Phil. Mag.* 7. *pp.* 345–352, *Feb.*, 1929.

The photographic method is used to obtain approximate values for the duration of the impact at various positions along the string for hammers of mass 0·82 and 2·8 times that of the string. The results are compared with those given by the approximate and the rigorous solutions of the Kaufmann equations. Experiments extending the work of George [see Abstract 1299 (1925)] on the motion of the shorter portion of the string during the impact are described. W. H. Ge.

ELECTRICITY AND MAGNETISM.

THEORY, ELECTROSTATICS AND ATMOSPHERIC ELECTRICITY.

1941. Propagation of Stationary Electric Currents in a Conductor Subjected to the Action of a Uniform Magnetic Field. Elena Freda. *Accad. Lincei, Atti,* 7. *pp.* 830–835, *May* 20, 1928.

This is a continuation of a previous paper on the same subject [see Abstract 899 (1929)]. The treatment is mathematical, and the following are the chief conclusions: In no conductor of three-dimensions in which there are punctiform electrodes can the distribution of the currents remain unaltered with and without the magnetic field. If all the three-dimensioned conductors are considered in which the electrodes that permit the entrance and exit of the current are punctiform or extended and of negligible resistance, it may be stated that the distribution of potentials may remain unaltered, with a magnetic field of arbitrary intensity, or without, only for the following two types: (*a*) Conductors limited by portions of two planes perpendicular to **H** constituting the free boundary, and of two or more tubular surfaces parallel to **H**, along each of which may be fixed an electrode of negligible resistance. (*b*) Conductors bounded by surfaces parallel to **H** constituting the free boundary, and by portions of planes perpendicular to **H**, each occupied by an electrode of negligible resistance. J. J. S.

1942. Sufficiency of the Differential Equations of Mathematical Physics. G. Giorgi. *Accad. Lincei, Atti,* 8. *pp.* 105–110, *Aug.,* 1928.

The author confutes the criticisms of W. Ritz directed against the fundamental laws of the electromagnetic theory of Maxwell and Lorentz. Ritz contends that the laws of electric phenomena cannot find sufficient basis in the systems of differential equations of the field. The author describes Ritz's reasoning as too subtle and compares it to discussing acoustic phenomena while denying the existence of the air. The insufficiency in the classical basis of mathematical physics lies not in the differential equations, but in accessory conditions which may be modified. J. J. S.

1943. Electric Field in Homogeneous Anisotropic Media. B. Rossi. *Accad. Lincei, Atti,* 8. *pp.* 146–154, *Aug.,* 1928.

The problem of the determination of the electric field in anisotropic media differs from the analogous problem relative to isotropic media by the fact that the correspondence between the vector of the electric force and the displacement vector is represented by a homograph of very general character. This has led to its being dealt with rarely or not at all. In this mathematical note the author shows how by application of the theory of vectorial homographs the treatment results in a notable simplification and leads frequently to the effective determination of the field. In general, the author's method, which he explains and illustrates by some examples, permits of reducing the problem of the determination of the field in an anisotrpoic medium to an analogous problem relative to an isotropic medium. J. J. S.

1944. Chart of Electromagnetic Energy Relations. W. E. Deming. *J.O.S.A. and R.S.I.* 18. *pp.* 50–52, *Jan.*, 1929.

To facilitate electromagnetic energy calculations the author has tabulated for different temperatures the corresponding electron speed, relativity factor, energy, frequency and wave-length *in vacuo.* The range in frequency is 3×10 to 3×10^{23}. Curves are constructed to illustrate the results obtained. R. S. R.

1945. Non-Crystalline Piezoelectric Substances. A. Meissner and R. Bechmann. *Zeits. f. techn. Physik*, 9. 11. *pp.* 430–434, 1928.

Various substances in the form of powder were examined to test their piezoelectric behaviour. The method of investigation is based on the fact that when piezoelectric substances are powdered the axes of the different grains of powder set themselves parallel to the external field. When the powder is then warmed a charge is developed on one of the electrodes placed upon it. This charge is a quantitative measure of the piezoelectric value of the substance concerned. From highly insulating substances, such as resin and wax, it was possible to obtain plates which exhibited piezoelectric properties. The plates were fixed between hot electrodes which were connected to the source of high potential. On cooling, the plates showed very pronounced piezoelectric peculiarities. Their piezoelectric moment is more or less persistent. By mixing crystalline powders of piezoelectric substances—*e.g.*, quartz powders—piezoelectric plates may be obtained whose moment remains constant. The piezoelectric coefficients of these plates are actually higher than those of crystalline quartz plates. J. J. S.

1946. Atmospheric Electricity during Dust Storms in North China. H. Pollet. *Comptes Rendus*, 188. *pp.* 406–409, *Jan.* 28, 1929.

The variation of atmospheric electricity was measured photographically by a Beaudoin quadrant electrometer and a radium capsule. In calm weather, on account of the clear skies, the diurnal variation with the double oscillation is well marked, but during the dust storms the potential rises in a few minutes to large negative values. Atmospherics are frequent before, during and after the storm. The charge per dust particle is $4{\cdot}4 \times 10^{-8}$ e.s.u. R. S. R.

DISCHARGE AND OSCILLATIONS.

1947. Radial and Parallel Striated Discharge Figures on Dielectric Liquids. T. Itoh. *Imp. Acad. Tokyo, Proc.* 5. *pp.* 9–11, *Jan.*, 1929. *In English.*

The discharge between a needle-point or thin metal filament and a metal plate, with a solid or liquid dielectric intervening, produces, on the surface of the dielectric, luminous figures which are radial when a needle is used, and consist of parallel strips or patches in the case of the filament. Reproductions of photos show that the same general characteristics are found in the figures on liquids as in those formed on solids. [See also Abstract 2455 (1928).] G. E. A.

1948. Motion of the Dielectric Liquid Accompanying the Striated Discharge Figure. T. Itoh. *Imp. Acad. Tokyo, Proc.* 5. *pp.* 12–14, *Jan.*, 1929. *In English.*

The general motion of the oil is such as might be produced by an air current moving radially from the needle-point or at right angles to the filament. [See preceding Abstract.] G. E. A.

1949. Conditions for the Normal Kathode Fall. M. Steenbeck. *Zeits. f. Physik,* 53. 3–4. *pp.* 192–197, 1929.

The author shows, by a detailed discussion of the mechanism of the setting-up of the glow discharge, how the Compton and Morse postulate comes about. The latter states that for a steady discharge the potential distribution required is that for which the ionisation produced in the gas by an electron emanating from the kathode is a maximum [see Abstract 161 (1928)]. It appears that the transformation of the Townsend into the glow discharge results from condensation of the discharge about a position of particularly high space charge density. The current density rises until the potential distribution most favourable to ionisation is attained. W. S. S.

1950. Spectral Phenomena of Spark Discharges. W. Clarkson. *Phil. Mag.* 7. *pp.* 322–331, *Feb.*, 1929.

In the first part of this paper it is shown that the principal properties of spark discharges, both electrical and spectral, may be derived from general principles, which are outlined and discussed. The close correlation between the derived and the observed data show that the scheme, which is based on a set of dynamic characteristic curves, accounts satisfactorily for the experimental facts. In the second part the ideas advanced are applied to the quantitative variations of the spectral intensities in the simplest spark discharge and the single-condenser discharge. It is shown that the unexpected complexities here revealed are but accidental and that the true form of these variations is as theoretical considerations would demand. A. W.

1951. Spark Potentials at Pressures below Atmospheric Pressure, and Minimum Potential with respect to Electrode Function. F. Klingelfuss. *Zeits. f. Physik,* 53. 1–2. *pp.* 154–156, 1929.

Calculates the electronic charge by means of a simple equation derived from the energy equation for the minimum potential, and obtains a value which closely approximates to that obtained by Millikan. Further, shows that the universal Boltzmann constant k and the absolute gas constant R_o can be represented by constants obtained from the same energy equation. [See Abstracts 1267 and 1630 (1929).] R. C. F.

1952. Scattering of Canal Rays. C. Gerthsen. *Ann. d. Physik,* 87. 8. *pp.* 1000–1002, *Dec.* 18, 1928.

A note calling attention to an error in Homma's calculation of the angle of deflection in his paper on the scattering of canal rays on their passage through solid bodies [see Abstract 2674 (1926)]. The number of particles in equally wide zones on a sphere, not rings of equal breadth on a flat surface, should be considered. Figures are given showing the correction which this involves in Homma's curves. Thus, the correspondence with the scattering law of a-rays supposed by Homma to occur does not hold good. J. J. S.

1953. Positive Ion Currents in the Positive Column of the Glow Discharge in the Noble Gases. W. Uyterhoeven. *Nat. Acad. Sci., Proc.* 15. *pp.* 32–37, *Jan.*, 1929.

A study was made of the positive column of the glow discharge in the noble gases, using Langmuir's method. The results obtained differed markedly from those reported by Langmuir in his work on mercury vapour and could not be interpreted on the basis of his theory. The experiments were carried out in Ne, Ar and He, using plane collectors with a guard-ring (Ni, Mg, C). The discharge tube was of the normal cylindrical type with hot kathode. The pressures used were usually Ne 0·02 mm., Ar 0·01 mm., He 0·04 and 0·1 mm. The volt-ampere characteristics of a sounding electrode were obtained for the condition $V_g << O$ (V_g being the potential of the collector with respect to the space), and for V_g slightly negative. The measured values of the space charge were found to be about twice those calculated from the Child-Langmuir equation and increased with decreasing values of V_g. Several possible explanations for these discrepancies are suggested, grouped under the headings: (1) secondary electron emission from the metal plate, and (2) ionisation in the sheath. These possibilities are briefly discussed, but no definite conclusions are drawn.

An error in a previous paper [see Abstract 2483 (1928)] is stated to have only a small effect on the constants of the final formulæ. A. W.

1954. Abnormal Form of Current-Voltage Curve with Strongly Ionised Gas at High Pressure. R. Thaller. *Phys. Zeits.* 30. *pp.* 59–61, *Jan.* 15, 1929.

In ordinary cases the current-voltage curve for a gas ionised by X-rays, β-rays, α-rays or ultra-violet light rises rapidly at first as the voltage increases, then more slowly until saturation is reached, and then becomes for a time horizontal. For still higher voltages it rises rapidly again, and a discharge or " avalanche " of electricity is produced. The author describes an experiment in which a high-output Lenard tube was used to ionise the air in a hemispherical ionisation chamber at ordinary atmospheric pressure. The current-voltage curve started as a straight line sloping upwards; there was no sign of its bending over to the horizontal, but instead of this at a certain voltage it shot up suddenly towards the vertical, and a discharge took place. H. N. A.

1955. Efficiency of Electron Impact Leading to Resonance in Helium. G. Glockler. *Phys. Rev.* 33. *pp.* 175–188, *Feb.*, 1929.

The efficiency of resonance impact between electrons and helium atoms has been studied as a function of the energies of the impinging electrons. The transition studied is $1^1S \rightarrow 2^3S$ at 19·77 volts. The range of energies is 0·8 volt, *i.e.*, from 19·77 to 20·55 volts. The efficiency with which electrons make inelastic impacts rises to a maximum 0·18 volt beyond the resonance potential of 19·77 volts and then decreases. The maximum average efficiency for electrons of 19·95 volts energy is estimated to be 0·002. The measurements were carried out by comparing the velocity distribution of the electrons leaving an equipotential surface with the drop in current as observed in the inelastic impact method of Franck, and similarly by comparing the velocity distribution of the electrons with the distribution of the positive current caused by them in a Lenard experiment. Both types of measurement yield similar results. AUTHOR.

1956. Ionisation by Slow Electron Impact of Ammonia and Hydrogen Sulphide. J. H. Bartlett, Jr. *Phys. Rev.* 33. *pp.* 169–174, *Feb.*, 1929.

The ionised gases were studied by means of positive ray analysis.

With NH_3, ions at $m/e = 15$, 16 and 17 were found; these are assigned to $(NH)^+$, $(NH_2)^+$ and $(NH_3)^+$, ionisation potentials $11{\cdot}2 \pm 1{\cdot}5$ volts, $12{\cdot}0 \pm 1{\cdot}5$ volts and $11{\cdot}2 \pm 1{\cdot}5$ volts respectively. From the proportions of these ions at different pressures it appears that $(NH_3)^+$ and $(NH_2)^+$ result directly from the electron impact with NH_3, while $(NH)^+$ is probably produced from $(NH_3)^2$ by a reaction such as $(NH_3)^+ + NH_3 = (NH)^+ + H_2 + NH_3$ (a collision). Very small peaks were observed in the mass spectrum at 14 and 18; these are probably due to $(N)^+$ and either $(NH_4)^+$ or $(H_2O)^+$; they are caused by collisions between ions and neutral molecules or by impurities. With H_2S three types of ion were observed, at $m/e = 32$, 33 and 34, and seem to be $(S)^+$, $(HS)^+$ and $(H_2S)^+$; ionisation potentials approximately $10{\cdot}4$, $16{\cdot}9$ and $15{\cdot}8$ volts; no secondary processes seem to occur and no $(S_2)^+$ ions were observed. In both NH_3 and H_2S very few, if any, hydrogen ions, and no negative ions, were observed. H. N. A.

1957. Probability of Excitation by Electron Impact in Neon. R. d'E. Atkinson. *Roy. Soc., Proc.* 122. *pp.* 430–442, *Feb.* 4, 1929.

The analysis applies to the Townsend type of experiment in which currents of the form $i = i_0 e^{ax}$ are found on varying the distance x between two parallel plates in a gas at comparatively high pressures. The line of attack is to determine the distribution of electron energies in the stream, assuming a mean probability for an inelastic collision for all electrons whose energies lie between the first critical potential and the ionisation potential. An equation for this probability is obtained in terms of the ionisation and first critical potential, and the empirical constants in the Townsend formula. In obtaining the mean probability per collision, Hertz's formula for the total number of collisions has to be employed, the validity of this procedure being rather uncertain. It is estimated from new measurements on neon by Townsend and McCallum that the mean probability that collisions will be inelastic equals about 5 %. W. S. S.

1958. Emission of Electrons. F. Rother and E. Münder. *Phys. Zeits.* 30. *pp.* 65–68, *Feb.* 1, 1929. *Paper read before the Deut. Naturforscher u. Ärzte, Hamburg, Sept.*, 1928.

On plotting the logarithm of the current against the square root of the potential gradient, the forced emission of electrons in a high vacuum shows a series of straight lines, and not curves, as found by Gossling and by Millikan and Eyring [see Abstract 1435 (1926)]. The authors used a wire stretched along the axis of a tantalum cylinder. The results are in accordance with Schottky's theory. The curves obtained by Millikan may be due to the disintegration of the thorium layer on the molybdenum wire. E. E. F. d'A.

1959. Thermionic Emission Constant A. R. H. Fowler. *Roy. Soc., Proc.* 122. *pp.* 36–49, *Jan.* 1, 1929.

The main object of this paper is to apply Nordheim's theory of the emission coefficient of electrons from metals so as to explain the remarkable relation between the constants A and x of the thermionic emission formula, first recorded by O. W. Richardson and recently reformulated by Dubridge [see Abstract 1692 (1928)]. This theory regards the emission as due to the passage of electrons through simple surface potential steps and double layers, to be calculated according to wave mechanics. The author concludes that the theory gives a satisfactory account of the facts wherever it can be properly applied, and explains certain apparent discrepancies between the observed and theoretical values of A.

E. E. F. d'A.

1960. Emission of Secondary Electrons from Insulators and Connected Phenomena. H. Daene and G. Schmerwitz. *Zeits. f. Physik*, 53. 5–6. *pp.* 404–421, 1929.

The beam of kathode rays passed into a cylindrical box at the centre of which was placed a plate of insulating material which could be turned so that its normal made different angles with the beam. A Faraday cage was mounted in such a way that it could be placed in different positions, so as to receive the electrons leaving the insulating plate at different angles. The inside of the apparatus was evacuated. Curves were obtained showing the angular distribution of these secondary electrons; they did not confirm the explanation of the effect discovered by Wehnelt which has been given by Klemperer and Joffé, but showed that reflection of the primary electrons did not take place to such an extent as to explain the strong drop in the number of secondary electrons observed at a certain angle, which depended on the position of the insulator. The authors advance a new theory based on the formation of a negative space charge on the surface of the insulator owing to the penetration of electrons. It is shown that the field due to this space charge causes the primary and secondary electrons to alter their directions in such a way as to produce the observed effects. H. N. A.

1961. Photoelectric Effect during Changes of State of the Kathode. A. Goetz. *Zeits. f. Physik*, 53. 7–8. *pp.* 494–525, 1929.

A continuation of the work on the emission of melting kathodes [see Abstract 2750 (1927)], using a Hoffmann electrometer, which measures down to 10^{-18} ampere. Measurements were made in the region from 2300 to 2900 Å., and at temperatures ranging from 50° to 550°. The photoelectric emission is independent of the temperature so long as there is no change of state or allotropic form. The photoelectric melting curve shows that hexagonal tin becomes unstable below 200°.

E. E. F. d'A.

1962. Propagation of Electromagnetic Waves in a Stratified Medium. D. R. Hartree. *Cambridge Phil. Soc., Proc.* 25. *pp.* 97–120, *Jan.*, 1929.

The equations of propagation of electromagnetic waves in a stratified medium (*i.e.*, a medium in which the refractive index is a function of one Cartesian coordinate only) are obtained first from Maxwell's equations for a material medium, and, secondly, from the treatment of the refracted wave as the sum of the incident wave and the wavelets scattered by the particles of the medium. The equations for the propagation in the presence of an external magnetic field are also derived by a simple extension of the second method. The significance of a reflection coefficient for a layer of stratified medium is discussed, and a general formula for the reflection coefficient is found in terms of any two independent solutions of the equations of propagation in a given stratified medium. Three special cases are worked out for waves with the electric field in the plane of incidence: (1) A finite, sharply bounded medium which is totally reflecting at the given angle of incidence. (2) Two media of different refractive index with a transition layer in which μ^2 varies linearly from the value in one to that in the other. (3) A layer in which μ^2 is a minimum at a certain height and increases linearly to 1, above and below that height, at the same rate. For cases (2) and (3) curves are given showing the variation of the reflection coefficient with the thickness of the stratified layer. Case (3) approximates to the conditions in the Heaviside layer.

A. W.

1963. Investigation of Barkhausen-Kurz Oscillations in Magnetic Fields. M. Forró. *Ann. d. Physik,* 1. 4. *pp.* 513–528, *Feb.* 25, 1929.

An experimental study was made of the effect of a magnetic field on oscillations of the Barkhausen-Kurz type. Three types of oscillations were found. In the first the oscillations show an increase of amplitude as the field is increased up to a certain value, beyond which the amplitude dies off. The oscillations cease entirely for fields of such value that the electrons fail to reach the anode. The wave-length decreases as the field strength is increased. The greatest decrease observed was in the interval from 25·77 to 57·98 Gauss, the decrease being 16·7 cm., the wave-length for a field of 25·77 Gauss being 65·6 cm. The second type of oscillations was of appreciably greater wave-length and much greater energy. This type was observed with a tube with anode diameter 16 mm. With this type of oscillations increase of the field strength causes a decrease of amplitude, but the wave-length remains unchanged. This type appears to be identical with the Gill-Morell oscillations. The third type of oscillations was observed with a tube having an anode diameter of 8 mm. and with other tubes with high grid potentials. The wave-length was very small (less than 30 cm.) and the energy also very small, rendering observation difficult. Variation of the magnetic field did not appear to affect the character of these oscillations. [See Abstract 177 (1928).]

A. W.

ELECTRICAL PROPERTIES AND INSTRUMENTS.

1964. Electrical Conductivity. W. J. de Haas. *J. de Physique et le Radium,* 9. *pp.* 265–277, *Sept.,* 1928.

The author describes experiments made in collaboration with Sizoo and Voogd on superconductors. Such metals show effects of hysteresis in a magnetic field for electrical resistance. Quick changes in the resistances of superconducting metals were observed and explanations are considered. When a superconductor is placed in a sufficiently intense magnetic field its curve of resistance is that of a normal metal. The following details were observed in various researches: (1) For all the resistances examined the effect of hysteresis in the magnetic disturbance of the superconductivity is evident. (2) The return of resistance by increase of the magnetic field is produced as a general rule in a continuous way. (3) The disappearance of the resistance through diminution of the magnetic field takes place without exception in a discontinuous manner and in reality by a succession of jumps whose number and height are different for different resistances. (4) The hysteresis and the discontinuities are produced both in a transversal and in a longitudinal field. (5) The number, position and height of the jumps—*i.e.*, all the descending line—are independent of the strength of current which serves to measure the resistance. (6) The width of the hysteresis figure at a given temperature differs a little from one resistance to another. The superconducting state of matter is a new phase of solid matter, a phase which may be stable or unstable. J. J. S.

1965. Disturbance of the Superconductivity of Thallium by Magnetic Fields. W. Tuyn. *K. Akad. Amsterdam, Proc.* 31. 7. *pp.* 687–691, 1928. *Comm. No.* 191*b from the Phys. Lab., Leiden.*

Measurements of the dependence of the magnetic threshold value on temperature pointed, in the case of tin and indium, to the relation $H(1/2) = h(T_s^2 - T^2)$, where H(1/2) is the magnetic field which restores half of the resistance, h a constant and T_s the vanishing-point temperature. These measurements were made on micro-crystalline wires in fields which were gradually increased in strength at constant temperature, the direction of the field being transverse to that of the current. In 1924 measurements of the same kind were made with a resistance of thallium, but between 2·5° and 1·6° K. only. Tl – 1916 – VIII, with which the superconductivity of thallium was measured for the first time, was used, and the method employed was that of compensating the potential at the extremities of the known and of an unknown resistance, connected in series, by means of a Diesselhorst compensation apparatus free from thermal forces. The results obtained for the ascending line are given in five tables. Some points obtained on the descending line indicate that thallium shows the hysteresis phenomenon. With thallium the transverse effect does not satisfy a quadratic relation as closely as in the case of tin; deviations up to 5 % are found between the observed values and those calculated from the equation $H(1/2) = -25{\cdot}4\,T^2 + 154{\cdot}9$, but the temperature scale is not yet accurately known in this region. J. J. S.

1966. Ohm-Fourier Law of Conduction. S. Ray. *Zeits. f. Elektrochem.* 34. *pp.* 753–756, *Nov.*, 1928.

An interesting theoretical discussion of the meaning of Ohm's law which was originally read at the Indian Science Convention in Calcutta in December, 1919. The author calls attention to the help towards the understanding of the nature of electrical conduction which can be got from the analogy of Fourier's form of the law of conduction, and discusses recent theories of electronic conduction. J. J. S.

1967. Imperfect Contacts with Direct Current. R. Audubert and (Miss) M. Quintin. *Comptes Rendus*, 187. *pp.* 972–974, *Nov.* 26, 1928.

A sheet of oxidised silicon associated with a body of moderate conductivity such as charcoal, PbS, PbO^2, MnO_2, Cu_2S, SnS, Ag_2S, exhibits unilateral conductivity, the resistance being more feeble when the silicon is positive. This, as is known, is connected with the existence of a pellicle of silica. Experiments were chiefly made with silicon-charcoal, which has no hysteresis or other complications. The silicon was used in the form of plates of 2 × 3 cm. oxidised, and the other electrode consisted of various forms of charcoal. The characteristic $i = f(e)$ was determined, i being the current and e the fall of potential between the electrodes. If the curve $\frac{1}{r} = \frac{i}{e} = \phi(e)$ is constructed, r being the apparent resistance, for the two polarities two straight lines are obtained which intersect in the same point of the axis of the ordinates, and of which the difference of inclination indicates the dissymmetry. Thus the characteristics may be represented by two branches of parabolæ. From its stability and reversibility the contact formed of silicon and charcoal is particularly suitable for the study of the phenomenon dealt with. J. J. S.

1968. Effect of Pressure on the Electrical Resistance of Three Series of Alloys. P. W. Bridgman. *Am. Acad., Proc.* 63. *pp.* 329–345, *Dec.*, 1928.

The following alloy series have been examined up to a pressure of 12,000 kg./cm.^{2}; Fe–Co; Fe–Ni; Ni–Cu. Results are given for the specific resistance, the pressure coefficient and the temperature coefficient. In all cases the pressure coefficient of a pure metal is increased by the addition of a second. A brief general discussion is given of the possible relation of the results to the crystal structure of the alloys and also of their significance from the point of view of a theory of electrical conductivity. A. A. D.

1969. Compressibility and Pressure Coefficient of Resistance of Zirconium and Hafnium. P. W. Bridgman. *Am. Acad., Proc.* 63. *pp.* 347–350, *Dec.*, 1928.

The zirconium was in the form of a very pure wire. Its compressibility at 30° C. and 75° C. is given up to 12,000 kg./cm.^{2} The specific resistance at 30° C. is 49×10^{-6}, and the mean temperature coefficient between 0° and 100° C. is 0·0043. The resistance deminishes under pressure (normal behaviour), but the coefficient is unusually small. The hafnium was in the form of a short rod. The results are more approximate than in the case of zirconium. The specific resistance (at 30° C.) is 36×10^{-6} and the temperature coefficient 0·004. The pressure data are expressed by means of numerical formulæ. A. A. D.

1970. New Carbon Resistance. C. A. Hartmann and H. Dossmann. *Zeits. f. techn. Physik*, 9. 11. *pp.* 434–438, 1928.

Description of a resistance formed from a very thin layer of a pure crystalline carbon of the glance coal or metallic carbon series. The resistance is of specially simple build, of high load capacity and great constancy, and can be made with values between 10 and 10^7 ohms. Such resistances are usable not only in the usual way in electron tube connections of all kinds, but also with advantage in d.c. and a.c. measurements, as also for high tension. Details are given of the peculiarities of the conductor, its specific resistance, temperature coefficient and other characteristics. J. J. S.

1971. Current Conduction in High Ohmic Resistances and Solid Insulators. F. Regler. *Phys. Zeits.* 29. *pp.* 869–873, *Dec.* 1, 1928.

Referring to Seeliger's conclusions as to conduction in solid insulators [see Abstract 3104 (1928)], the author brings forward an explanation of the dependence of the conductivity of high ohmic resistances and solid insulators on external influences. This he has already referred to in his paper on the theory of contact detectors [see Abstract 2808 (1928)]. The cause of the change of resistance in dependence on the tension is amongst others to be sought in the changes in value experienced by the unit cells under the influence of an electric field. The author has found a large portion of the resistance in the surfaces of separation between the microcrystals. On this supposition Ohm's law has no validity for these bodies, but rather other laws which the author has found experimentally and intends to deal with in a later paper. J. J. S.

1972. Electrical Resistance and Magnetic Permeability of Iron Wire at Radio Frequencies. G. R. Wait, F. G. Brickwedde and E. L. Hall. *Phys. Rev.* 32. *pp.* 967–973, *Dec.*, 1928.

G. R. Wait [see Abstract 2403 (1927)], when investigating the magnetic permeability of iron and magnetite in high-frequency magnetic fields, did not observe a critical variation of the permeability at 3000 kilocycles (100 metres wave-length) as reported by Wwedensky and Theodortschik [see Abstract 763 (1923)]. It was suggested that the difference in the results might have been due to a difference in: (1) the kinds of iron investigated; (2) the strengths of the magnetic fields; and (3) the manner of suspending the iron sample. A sample of iron wire in which critical variations had been observed by Kartschagin and by Mitiaev was used in the present investigation with the same apparatus as had previously been used by Wait. A magnetic field of an intensity 0·5 gauss was employed and also a field of 0·01 gauss, in a field of which latter intensity Wwedensky and Theodortschik observed the critical variation. In no case was a critical variation in permeability observed.

Mitiaev [see Abstract 481 (1927)] observed that the resistance of iron wire to a high-frequency current and its internal self-inductance underwent a critical variation at about 3000 kilocycles. Calculations of the permeability involving these quantities gave results in substantial agreement with those of Wwedensky and Theodortschik on the variation of permeability with frequency. Resistances of iron wires were measured by the resistance-variation method (Bureau of Standard Circular 74), between 4300 and 2500 kilocycles (70 and 120 metres wave-length). No critical change within the limits of observable accuracy was detected.

J. J. S.

1973. Susceptibility and Change of Resistance of Metals in a Magnetic Field. F. Bloch. *Zeits. f. Physik*, 53. 3–4. *pp.* 216–227, 1929.

This is a theoretical and mathematical paper which deals with the subject from the point of view of the recently employed conception of electric conduction, which assumes that the conduction electrons of the metals are not free, but move in a periodic field of force. On this assumption their paramagnetic behaviour is investigated. Further, it is shown that the normal change of resistance of the metals in a magnetic field may be explained if, besides the influence of the Lorentz force investigated by Sommerfeld, the orientation of the rotation which here has a preponderating influence is at the same time considered. J. J. S.

1974. Measurement of the Thermoelectric Thomson Effect down to the Temperature of Liquid Hydrogen. G. Borelius, W. H. Keesom and C. H. Johansson. *K. Akad. Amsterdam, Proc.* 31. 10. *pp.* 1046–1058, 1928. *Comm. No.* 196*a from the Phys. Lab., Leiden.*

Measurements have been made with two wires of copper and silver alloyed with small quantities of gold. At very low temperatures the heat conductivity of pure metals increases so considerably that measurements are too uncertain. The alloys were measured down to 20° K., and pure copper down to 70° K. It will be possible to determine the Thomson effect for pure metals, or other alloys, by measuring their thermoelectric force against one of the alloyed wires which have been investigated, since $\sigma_1 - \sigma_2 = \mathrm{T}de/d\mathrm{T}$, where e is the thermoelectric force per degree of two metals, and σ_1 and σ_2 are their Thomson effects. The method is similar

to that employed by Borelius and by Borelius and Gunneson, and details are given of the apparatus used. Diagrams show the way in which the Thomson effect varies with the temperature and with the current for the different wires employed, the results being also given in tabular form.
H. N. A.

1975. Photoelectric or Thermoelectric Measurement of Small Displacements. G. D. Cristescu. *Phys. Zeits.* 30. *pp.* 24–27, *Jan.* 1, 1929.

The rays from a source of light rendered parallel by a collimator fall normally upon two equal gratings R_1 and R_2 mounted parallel, the one behind the other, at a close distance. The front grating R_1 (with 5 lines to the millimetre) is connected with the body, the displacement of which is to be measured. When the openings in the two gratings coincide, the light can pass through and is focussed on a thermoelectric or photoelectric cell, *e.g.*, a Moll thermocouple and galvanometer. The galvanometer deflections are photographically recorded on a rotating film. Modifications of the device for the suppression of diffraction fringes, etc., are described, and the limitations of the use of the instrument are discussed.
H. B.

1976. Dielectric Peculiarities of Nematic Liquids in Direct Magnetic and Electrostatic Fields. M. Jezewski. *Zeits. f. Physik,* 52. 11–12. *pp.* 878–881, 1929.

The capacity of a condenser filled with *p*-azoxyanisol and *p*-azoxyphenetol was measured in direct magnetic and electrostatic fields, and besides the fields were parallel and perpendicular. A weak electrostatic field (about 400 volts/cm.) produces no change of the capacity of the condenser placed in it. A strong electric field produces an increase of the dielectric constant of nematic liquids [see Abstract 960 (1929)] if they are put in parallel magnetic fields, and a decrease if they are placed in perpendicular magnetic fields.
J. J. S.

1977. Dependence of the Dielectric Constant of Insulating Materials on Frequency. P. Böning. *Zeits. f. techn. Physik,* 10. 1. *pp.* 20–23, 1929.

In a previous paper [see Abstract 2821 (1928)] the dependence of the dielectric constant of insulating materials on the applied potential was discussed and explained on the basis of a theory of ionic adsorption. The same theory is used here to explain the dependence of the dielectric constant on frequency. It is shown that the apparent dielectric constant increases with frequency to a limiting value, which is regarded as the true dielectric constant of the material. The theory agrees with published results for specimens of varnished paper boards and tubes.
A. W.

1978. Electric Polarisation in Insulators Resulting from Acceleration. E. Brody. *Zeits. f. Physik,* 52. 11–12. *pp.* 884–889, 1929.

If a crystal containing negative and positive ions of different masses is accelerated, there will occur in general an electric polarisation in the direction of motion during the period in which the acceleration acts. The magnitude of the effect to be expected, for certain crystal types and for isotropic bodies, is computed, and the possibility of experimental investigation of the effect is discussed.
W. S. S.

1979. Dielectric Constants and Absorption Indices of Several Alcohols for Short Electric Waves. S. Mizushima. *Imp. Acad. Tokyo, Proc.* 5. *pp.* 15–16, *Jan.*, 1929. *In English.*

In continuation of earlier work [see Abstract 2822 (1928)] the results of measurements of dielectric constants and absorption indices for several alcohols for a wave-length of 60 cm. are tabulated. The results for the alcohols confirm Debye's theory of anomalous dispersion. The results for glycerine do not support this theory, but if glycerine be colloidally dispersed so that the effective viscosity acting against the rotation of the molecule is quite different from the viscosity of the liquid in bulk, the discrepancy is explained. R. S. R.

1980. Electrical "Strength" of Liquid Insulating Materials. A. Gyemant. *Phys. Zeits.* 30. *pp.* 33–58, *Jan.* 15, 1929.

A general review of the subject, in which it is shown that the observations cannot be fully explained by assuming a limiting field intensity for each substance at which breakdown always takes place. Considers the influence of chemical constitution, physical structure, distribution of the electric field, distance between, condition and shape of the electrodes, conductivity of the liquid, time during which the voltage is applied, temperature, pressure. Concludes that the breakdown is not a breakdown of the molecules, but that there are indications that the surface tension and viscosity of the liquid are of importance. The author has formulated a theory connecting the breakdown with the gas adsorbed on the surfaces of the electrodes; under the influence of the field this is supposed to form bubbles, which are drawn out into narrow threads, and in the end form a gaseous connection between the electrodes through which the discharge takes place. Güntherschulze considers that the discharge is connected with the conductivity of the insulator; the ions in their movement produce strong local heating, with evaporation and formation of gas bubbles in which the discharge takes place. The author thinks it may be possible to combine the two theories. H. N. A.

1981. Current Measurements with a Compton Quadrant Electrometer. E. E. Watson. *Cambridge Phil. Soc., Proc.* 25. *pp.* 67–74, *Jan.*, 1929.

An attempt is made in this paper to extend the theory of the Compton electrometer to cover charge and current measurements and to illustrate it with actual observations. Compton, in his original paper, gives the theory of the instrument [see Abstract 1549 (1919)], and a recent note by Cox and Grindley [see Abstract 442 (1928)] deals with its use. But the electrometer is more difficult to use than the Dolezalek type and, therefore, this paper, which explains its theory and behaviour, will be useful to those who intend to use Compton's electrometer for charge or current measurements. For absolute measurements of current the instrument can be calibrated by measuring the rate of drift for a single known current value.

J. J. S.

1982. Absolute Current Balance having a Simple Approximate Theory. L. F. Richardson and V. Stanyon. *Phys. Soc., Proc.* 41. *pp.* 36–40; *Disc.*, 41, *Dec.*, 1928.

A description is given of a simple form of current balance which, when tested experimentally by comparison with a standard ohm and a Weston cell, shows a probable error of only 1 part in 1000. The object of the construction of the balance was to provide an absolute instrument for purposes of instruction, which, for students preparing for the final B.Sc. in Physics of the University of London, would take a similar place to that filled by the tangent galvanometer in the case of intermediate students. The calculation of the force acting on the moving coil of the balance involves no pure mathematics beyond the standard of the Intermediate B.Sc. The coils are single-layer so that they can be made as precise helices in the future. In actual practice considerations of cost have led to irregularities of shape which leave the current uncertain by 5 parts in 1000. The simple theory of the instrument and details of its construction are given. A second approximation, depending upon a simple deduction from Laplace's equation, is given, which corrects the elementary theory and enables a more accurate measurement to be made. J. J. S.

1983. Vacuum Tube Potentiometer for Rapid E.M.F. Measurements. H. M. Partridge. *Am. Chem. Soc., J.* 51. *pp.* 1–7, *Jan.*, 1929.

Various applications of one or more triode values to various forms of apparatus suitable for the determination of *p*H values, electrode potentials, electro-titrations, etc., have been previously described, but most of these require a calibration of the valves, depend on constancy of the characteristics of the valves, and require sources of filament and plate potentials which will not vary during a considerable period. In the arrangement now described, the conventional bridge is replaced by a vacuum tube consisting of a tetrode and a triode. The inner grid of the four-element tube is used as the control grid, the outer grid is made positive to the filament by 45 volts, and the plate is operated at the potential 135 volts. When the inner grid of this tube is connected directly to the negative lead of the filament, the resulting grid voltage is zero and the plate current 1·95 milliamperes. Connection of a cell with an unknown e.m.f. between the inner grid and the filament with the negative side towards the grid results in an unknown negative grid voltage and in the plate current dropping to some lower value, an extremely weak current being drawn from the cell to be measured. A source of variable potential supplied by a dry cell or storage cell and spanned by a voltmeter is now inserted in the grid-filament circuit, so that the variable potential opposes the unknown e.m.f., the variable potential being altered until the plate current again becomes 1·95 milliamperes. The unknown cell is now given no currents and the true e.m.f. of the cell may be read direct from the voltmeter. The advantages are: (1) it is direct reading; (2) it is independent of the characteristics of the valves and of their power supply; (3) the " balance " condition is definite and very stable; (4) the results are dependent on the precision of the voltmeter; (5) the maximum current taken from the cell is of the order 10^{-9} ampere, the value at balance being zero, so that the unknown cell may be left continually in circuit; (6) the resistance of the cell being measured is unimportant; (7) when it is used with a cell containing properly prepared electrodes, the *p*H values may be rapidly determined and are reproducible to within 0·02 of the Sörensen unit. T. H. P.

1984. Nineteenth Exhibition of the Physical and Optical Societies. E. H. Rayner, A. C. Jolley, E. Griffiths, R. L. Smith-Rose. *Journ. Sci. Instruments*, 6. *pp.* 57–65, *Feb.*, 1929.

Notes on exhibits: Laboratory electrical instruments; commercial electrical instruments; temperature-measuring equipment; wireless apparatus. A. D.

ALTERNATING CURRENTS AND MAGNETISM.

1985. Magnetic Susceptibilities of NaCl and NaBr Solutions. M. H. Trytten. *Univ. Pittsburgh, Bull.* 25. *pp.* 35–44, *Oct.* 25, 1928.

The susceptibilities of NaCl and NaBr were determined by the Quincke ascension method, water being taken as the standard. The liquid was contained in a U-tube of which one limb was wide, and had its upper end closed by the lower plate of a condenser forming part of a Hartley oscillatory circuit. The change of the plate current was used to measure the change in condenser capacity. From this was derived the pressure applied to the liquid in the narrow limb by the magnetic field, and also the mass susceptibility of the solution. The values found were NaCl, $-0\cdot37 \times 10^{-6}$, NaBr, $-0\cdot33 \times 10^{-6}$. G. E. A.

1986. Magnetic Susceptibilities of the Alkali- and Alkaline Earth-Halogenides. K. Ikenmeyer. *Ann. d. Physik,* 1. 2. *pp.* 169–191, *Jan.* 19, 1929.

A differential method was applied to measure the effect of a non-homogeneous field on a rod suspended in an aqueous solution of the salt under test. The susceptibility of the solution is a linear function of the concentration within the range of the investigation. It follows that there is no perceptible mutual action between the ions in the solution. Values are found for the molecular susceptibilities of the twenty salts investigated, and these give an approximately linear function when plotted with the sum of the nuclear charges of the ions forming the molecule. Thereafter the susceptibilities of the single ions are calculated. [See also Abstract 2366 (1925).] G. E. A.

1987. Magnetic Susceptibilities of Some Amalgams and Binary Alloys. W. G. Davies and E. S. Keeping. *Phil. Mag.* 7. *pp.* 145–153, *Jan.,* 1929.

The relative magnetic susceptibilities of dilute amalgams of Au, Sn, In, and Ga, with respect to that of Hg, were determined by means of a Curie-Chéneveau magnetic balance. The susceptibility (diamagnetic) decreases in absolute value as the concentration of the dissolved metal increases, but not linearly. The effect per atom added on the susceptibility of Hg is greater for In than for the other metals tried. The susceptibilities of two series of binary alloys, Cu-Mg and Cu-Sb, were also determined by the authors over a wide range of composition. The susceptibility-composition curves for Cu-Mg show a maxima corresponding to the eutectics on the ordinary equilibrium diagram, and conspicuous maxima corresponding to the known compounds $CuMg_2$ and Cu_2Mg. The equilibrium diagram for Cu-Sb is more complicated. In all cases annealing increases the susceptibility, and the effect is very marked in the region from 20 to 60 % of Cu. The only compound definitely indicated on the curve for the unannealed alloy is Cu_5Sb_2, but there is evidence of Cu_2Sb in the annealed alloy. This is the change which the equilibrium diagram indicates as likely on annealing. Here also prominent maxima on the curves correspond to the eutectics formed. Experimental details are given in the paper and also tables and diagrams giving the numerical results. J. J. S.

1988. Relation between Size of Crystal and Magnetic Properties of Pure Nickel. G. J. Sizoo. *Zeits. f. Physik,* 53. 5–6. *pp.* 449–457, 1929.

This paper continues previous work on electrolytic iron [see Abstract 612

(1929)] and investigates the conditions of recrystallisation for nickel. Only when the manganese content does not exceed 0·2 % were recrystallisation phenomena maintained by the mechanical-thermal process. Twin formation was a frequent occurrence. The magnetic properties were examined in connection with crystal size and the results now obtained for nickel were very similar to those previously found for iron (*loc. cit.*). H. H. Ho.

1989. Theory of Ferromagnetic Crystals. G. S. Mahajani. *Roy. Soc., Phil. Trans.* 228. *pp.* 63–114, *Jan.* 10, 1929.

An atomistic theory for magnetic phenomena in ferromagnetic crystals, of which a summary has been already published. [See Abstract 1910 (1926).] G. E. A.

1990. Diamagnetism of Ions of the Noble Gas Type. H. Kulenkampff. *Ann. d. Physik,* 1. 2. *pp.* 192–194, *Jan.* 19, 1929.

A comparison of Ikenmeyer's expression for the ionic susceptibility with that of Langevin as modified by Pauli shows that in the first approximation the mean square electronic path radius ($\overline{r^2}$) is independent of the number of electrons, and a numerical calculation gives $\overline{r^2} = (0{\cdot}531 \times 10^{-8})^2$, the quantity in brackets being the radius a_1 of the orbit in the Bohr hydrogen atom. The values of $\overline{r^2}$ for the three series of ions, halogen, alkali, and alkaline earths, are then expressed in terms of a_1 and Z_E, the number of electrons. G. E. A.

1991. Solar Diurnal Variation of the Earth's Magnetism. S. Chapman. *Roy. Soc., Proc.* 122. *pp.* 369–386, *Feb.* 4, 1929.

The author examines critically three theories put forward to account for the solar diurnal magnetic variation (S). The dynamo theory gives a good account of the general form of the current system shown diagrammatically by J. Bartels, but difficulties exist for the phase and intensity of the currents, the convective motion and conductivity of the layer not being known. Under certain assumptions regarding the temperature and composition of the upper atmosphere values are obtained for ν and K at different heights; these differ from Pedersen's values for reasons which are given. This leads also to a total conductivity four times Pedersen's value, but still only 1/5th that required. It is probably within the limits of error. Gunn's suggestion regarding a diamagnetic layer of the upper atmosphere being responsible for S was confirmed theoretically by the author, but reasons are given for the rejection. The further possibilities of the dynamo and "drift current + dynamo" theories are discussed, but the existing evidence does not permit a definite decision being taken between them. R. S. R.

RADIOGRAPHY AND ELECTROPHYSIOLOGY.

1992. X-Ray and Radium Protection. *Bureau of Standards, Circ.* 374. [8 *pp.*], 1929.

The X-ray and radium protection proposals that were adopted by the Second International Congress of Radiology are given in their final form. The section of the 1928 National Electrical Code dealing with X-ray and high-frequency apparatus is also given. The first set of recommendations are effective until the next congress in 1931.

CHEMICAL PHYSICS AND ELECTROCHEMISTRY.

1993. Influence of Adsorbed Films on Rates of Evaporation. R. P. Bell. *J. Phys. Chem.* 33. *pp.* 99–117, *Jan.*, 1929.

The rates of evaporation of chlorine are investigated from (i) a solution in carbon tetrachloride, and (ii) such a solution with addition of trichloroacetic acid. The solution is contained in a spherical flask filled so as to expose an area of about 3 cm.^{2}, over which a regulated current of air is passed at 25°C., the chlorine removed being absorbed in solution of potassium iodide. The rate of evaporation (R) is corrected for variations in air pressure. (i) From carbon tetrachloride solution R increases somewhat more slowly than the velocity of the air current (V), and varies directly as the concentration of the chlorine; it is about 1 % of the "ideal" rate deduced from the Herz-Knudsen equation, $R = P \times 0\cdot0583\sqrt{M/T}$, ($P$ = pressure of chlorine vapour; M = mol. wt.). The results are fairly in conformity with the Jablczynski and Przemski's equation [*J. Chim. Phys.*, 10,241, 1912]. (ii) Addition of trichloroacetic acid causes (with rare exceptions) a reduction in R up to 15 %; the ratio of this decrease to the rate in absence of acid is shown (*a*) to be independent of the chlorine concentration; (*b*) to vary directly with V; and (*c*) to increase rapidly with concentration of acid until this reached 1·4 %, after which there was no further increase. This (*c*) is considered to indicate that at this concentration a stable monomolecular film of acid is formed on the surface of the solution, a view which is supported by applying the Gibbs adsorption equation to the surface tension of such films determined by the drop-weight method. The utility of such measurements of rates of evaporation in investigations of adsorption from solution is urged. C. A. S.

1994. Adsorption of Potassium Chromate on Zinc. R. F. Reed and S. C. Horning. *J. Phys. Chem.* 33. *pp.* 136–137, *Jan.*, 1929.

It has been shown that potassium chromate reacts with a zinc surface, depositing on it a compound of chromium and making it less active. The adsorbed compound is probably either zinc chromate or potassium chromate, but the question can only be decided when the potassium, in addition to the chromium retained by the zinc, can be determined. H. H. Ho.

1995. Adsorption of the Surface of Binary Liquid Mixtures. R. S. Bradley. *Phil. Mag.* 7. *pp.* 142–145, *Jan.*, 1929.

The author points out that although the advantage of the impartial view that neither constituent of a binary mixture is to be regarded as the "solvent" has long been recognised, undue attention has been paid to the adsorption of one constituent without at the same time considering changes in the surface concentration of the other. In this mathematical note he illustrates this statement by reference to Rideal and Schofield's paper [see Abstract 2412 (1925)], in which $d\sigma / - RTd \log a$ is plotted, where σ is the surface tension of alcohol-water mixtures, a_1 the activity of the alcohol. These authors thus obtain a curve showing a maximum, but in reality they are plotting, not the surface concentration of alcohol, but $\Gamma_1 - \Gamma_2 . N_1/N_2$, where Γ_1, Γ_2 are the Gibbs's surface excesses, and N_1, N_2 the mol. fractions of alcohol and water respectively. In order to obtain Γ_1 and Γ_2 appeal must be made to some other relation, and this is given by the potential at the surface, as measured by Franklin. J. J. S.

1996. Adsorption Isothermals for Plane Platinum Surface. W. G. Palmer. *Roy. Soc., Proc.* 122. *pp.* 487–497, *Feb.* 4, 1929.

The method of the electric coherer has been employed to determine the adsorption isothermals of some typical substances on a plane platinum surface, and the results obtained confirm Langmuir's formula. The variation in the apparent area available for the adsorption of different substances is discussed in relation to the mechanism of adsorption and catalytic action. H. H. Ho.

1997. Adsorption at a Water Surface. Part I. B. W. Currie and T. Alty. *Roy. Soc., Proc.* 122. *pp.* 622–633, *Feb.* 4, 1929.

Measurements were made of the electric charge on small air bubbles under a variety of conditions. The results showed that if the bubble had a diameter greater than a definite critical size, the total charge on the bubble was independent of its diameter under all conditions. The charge on a bubble in very pure water was found to be $5 \cdot 4 \times 10^{-4}$ e.s.u., and the critical radius in this case was $0 \cdot 033$ cm. F. J. B.

1998. Hydrolytic Adsorption by Humic Acid. A. Ganguli. *Phil. Mag.* 7. *pp.* 317–322, *Feb.*, 1929.

It has been suggested by Mukherjee [see Abstract 91 (1923)] that the acidity of soils can be explained in the light of hydrolytic adsorption. The work here described was undertaken to test this view. Experiments were carried out on the adsorption of various electrolytes by humic acid, and the concentration of the hydrogen ions was determined by an electrometer method. In each case it was found that free acid was liberated, the concentration of the hydrogen ions being a function of the concentration of the electrolyte. The effect of valency was quite definite, the order for kations with a common anion being $Al > Ba > K > Na$, and for anions with a common kation $Cl < SO_4$. It therefore appears that the acidity of soils can be explained as due to hydrolytic adsorption of electrolytes by humic acid, which is an essential constituent of soils. A. W.

1999. Determination of Vapour and Liquid Compositions in Binary Systems. I. Methyl Alcohol-Water. J. B. Ferguson and W. S. Funnell. *J. Phys. Chem.* 33. *pp.* 1–8, *Jan.*, 1929.

Application of an all-glass circulating apparatus renders it possible to determine the composition of the vapour in equilibrium with a binary liquid by a method which largely eliminates the uncertainties concerning both the attainment of equilibrium and the assumptions underlying the calculations, and requires only small samples of material. This method, described in detail, is used for the investigation of the system methyl alcohol-water at 39·9° C. Examination of the results obtained by Wrewsky for this system [*Zeits. Phys. Chem.* 81. p. 1, 1912–1913] by means of Lash Miller's abacus [*Chem. Rev.* 1. p. 293, 1925] shows that these appear to be subject to a systematic error which increases as the solutions become more dilute, and a similar study of Bredig and Bayer's results [*Zeits. phys. Chem.*, 130. p. 1, 1927] proves that the vapour compositions for the dilute solutions are inconsistent with those for the more concentrated ones. Moreover, the partial pressures given by Wrewsky indicate that for water there is first a negative and then a positive deviation from Raoult's law, and since he indicates a similar deviation for the system ethyl alcohol-water, whilst Dobson [*Chem. Soc., J.* 127. p. 2866, 1925] found only a positive deviation at a lower temperature, it seems probable that the positive and negative deviation was due to experimental error. This assumption is confirmed by the results now given, and it is likely that in the previous work refluxing occurred to some extent. The vapours of the two components mix without noticeable change in volume, the mixed vapours forming a perfect gaseous solution. T. H. P.

2000. Behaviour of Cellulose Nitrate Gels in Polarised Light. A. J. Phillips. *J. Phys. Chem.* 33. *pp.* 118–130, *Jan.*, 1929.

Various commercial samples of cellulose nitrate have been examined in polarised light (with crossed Nicols and also with a gypsum plate in addition) under the microscope. The variation in colour thus observed is shown to be a function of the dispersion of the cellulose nitrate. While on the whole a higher percentage of nitrogen is correlated with low dispersion, and it is probable that with uniform nitration the range of colours would follow a spectrum wheel with low nitrogen in the yellows and high in the blues, variations in manufacture and subsequent treatment have so great an effect that no definite correlation is possible. Thus, the colour is influenced by the strength and ratio of the nitrating acids, time and temperature of nitration, and the various methods for reducing viscosity (ultra-violet light, heat, or superheating in water). Differences in dispersion probably due to irregularities in nitration are clearly brought out. C. A. S.

2001. Ionic Equilibrium in Colloidal Solutions. H. D. Murray. *J. Phys. Chem.* 33. *pp.* 138–142, *Jan.*, 1929.

From the present investigation it would appear that those electrolytes are the most efficient stabilisers of colloid particles which contain an ion in common with the substance of the particle, and that many of the typical properties of such particles may be explained on the assumption that these electrolytes are adsorbed at the particle surface, and are free to dissociate, dissociation taking place in such a way that the ion remaining attached to the particle surface is that of the same chemical nature as the substance of the particle. H. H. Ho.

2002. Cold Work and Chemical Properties of Metals. G. Tammann. *Zeits. f. Elektrochem.* 35. *pp.* 21–28, *Jan.*, 1929.

The work done upon iron by mechanical stress is not all converted into heat, but according to Hort 5 to 15 % of it remains in the iron as potential energy. When a metal is stretched, the friction increases with increasing deformation, whilst one should expect it to decrease; the friction is not that between planes, however, but due to alterations in the atoms. Abraded with emery the metal surface becomes harder and more corrodible (less noble), and the potential higher; that cannot be due to the appearance of octahedral planes, which are also observed when the electric potential remains unchanged. This view is supported by various facts. Cold work shifts the limits of corrodibility of alloys or mixed crystals (Au-Cu) in the direction of the more noble component. Hard metals deposit other metals electrolytically more rapidly than the same metals in the soft condition; this effect does not show much with quick deposition from concentrated solutions, because the deposited layer alters the conditions, but is distinct with the very diluted solutions of RaF and soft and hard iron and silver. Mercury wets hard silver and its mixed crystals with Au, Sn, Cd more quickly than the soft metal. The rates of solution of iron and of the reduction of silver bromide are increased by cold work. Fresh cleavage planes are more rapidly attacked by water than old faces. Rolling changes the colour of some alloys of Au-Ag-Cu more into yellow. H. B.

2003. Short Method for Calculating Dissociation in Homogeneous Systems. Application to [Carbon] Dioxide. P. Jolibois and P. Montagne. *Comptes Rendus,* 187. *pp.* 1145–1147, *Dec.* 10, 1928.

A graphical method applying a linear nomogram and a triangular diagram for the rapid solution of equations for dissociations involving the gas laws. The nomogram and diagram for the case of carbon dioxide are given. A. J. M.

2004. Photochemical Decomposition of Benzaldehyde. M. de Hemptinne. *J. de Physique et le Radium,* 9. *pp.* 357–364, *Nov.,* 1928. *Ann. Soc. Sci. de Bruxelles,* 48. *pp.* 98–100, *Dec.,* 1928.

The author shows that the ultra-violet rays corresponding to the region of total absorption produce the decomposition of the vapour of benzaldehyde. The absorption spectrum changes with rise of temperature. The wave-length of the active rays changes at the same time. The diminution of the energy necessary for decomposition is of the same order of magnitude as the increase of internal energy due to the rise of temperature. The same decomposition can be produced thermally by heating from 400° to 500° C. and also by the brush discharge. E. E. F. d'A.

2005. Further Test of the Radiation Hypothesis [of Chemical Reactions]. L. S. Kassel. *Am. Chem. Soc., J.* 51. *pp.* 54–61, *Jan.,* 1929.

It has been suggested that the maintenance of the velocity of decomposition of nitrogen pentoxide may be due to assistance from radiation, which becomes important only at low pressures. The experiments now described show, however, that radiation of wave-length less than 5 μ is not capable of increasing the rate of the reaction even at low pressures, and it is concluded that the important region, if such there be, will probably lie between 5 μ and 10 μ, but that it is difficult to see how enough radiation can be absorbed to maintain the velocity of the reaction. An experiment to detect this activity is suggested, and other alternative explanations are discussed, but no definite conclusion is reached. T. H. P.

2006. Photo Decomposition of Ethyl Iodide. T. Iredale. *J. Phys. Chem.* 33. *pp.* 290–295, *Feb.,* 1929.

The photo decomposition of ethyl iodide was studied by determining the iodine liberated when it was exposed to light of definite wave-length. The source of the light was a quartz mercury-vapour lamp, and a 1-cm. thickness of a neutral 0·03 % solution of diamond fuchsin was employed to isolate the wave-length region of 365 $\mu\mu$. The absorption and the radiant energy from the lamp were measured by a Moll thermopile and galvanometer. The liberated iodine was determined by titration with a very dilute solution of sodium thiosulphate. The results indicated that the decomposition was a very simple process, one quantum effecting the detachment of an iodine atom from one molecule. F. J. B.

2007. Relation between Photochemical Reactivity and Fluorescence of Organic Compounds. G. Kögel. *Zeits. f. Wiss. Phot.* 26. *pp.* 311–319, *Feb.,* 1929.

From a consideration of the photochemical reactivity of many fluorescent aromatic compounds it is concluded that the idea of Pringsheim that different parts of a molecule are responsible for fluorescence and for photochemical action is in general true. But the energy changes induced in the one part may affect the reactivity of the other, and hence of the molecule. Fluorescence in the case of the aromatic closed-ring compounds is an indication of *potential* photochemical activity; in aliphatic and aliphatic aromatic compounds it is an indication of actual photochemical activity.

J. E.

2008. Hysteresis Phenomena in Physical-Chemical Systems. N. v. Raschevsky. *Zeits. f. Physik*, 53. 1–2. *pp.* 102–106, 1929.

It is shown that the state of any physical-chemical system, which has several equilibrium states according to prescribed external conditions, depends on the previous history of the system. Another characteristic of such systems is bound up with the appearance of this hysteresis, *viz.*, that the state of the system not only depends on the manner followed by the external conditions, but also on the velocity with which they are fulfilled.

H. H. Ho.

2009. Equilibria and Reactions in Systems with Very Great Specific Surface. N. v. Raschevsky. *Zeits. f. Physik*, 53. 1–2. *pp.* 107–129, 1929.

In this paper the results of previous investigations [see Abstracts 793 and 2052 (1928)] are supplemented and summarised. It is further shown that in any shaped system in which the surface energy cannot be neglected, the limitation of the number of phases demanded by the usual phase theory does not arise, since a component can be found in several co-existing phases. Different general characteristics of such systems are now investigated, and particularly the case where the system has several equilibrium constitutions, and consequently exhibits hysteresis phenomena. H. H. Ho.

2010. Inflammation Temperatures of Combustible Gas Mixtures. M. Prettre and P. Laffitte. *Comptes Rendus*, 188. *pp.* 397–399, *Jan.* 28, 1929.

In a previous investigation the inflammability data were given for mixtures of hydrogen and air [*ibid.*, 187. p. 763, 1928], the values obtained being appreciably lower than those of preceding authors. The present work examines systematically the influence of low pressure in the combustion chamber on the inflammation temperatures of hydrogen-air mixtures containing 60 % and 40 % of hydrogen. It is found that when some residual gas from the preceding combustion is present, the inflammation temperature is considerably raised. Similar determinations have been made for mixtures of hydrogen and oxygen in which carbon dioxide is present in amount relative to oxygen as nitrogen in air. As in the former case, the variation of the inflammation temperature is a function of the initial pressure, and similar elevation was found when residual gas was present.

H. H. Ho.

2011. Absolute Velocities of the Water Molecules Expelled during Dehydration of Crystal Hydrates. Part II. A. S. Predwoditelew. *Zeits. f. Physik*, 54. 1–2. *pp.* 159–160, 1929.

The paper under the above title [see Abstract 637 (1929)] contained certain inaccuracies which are now corrected, *viz.*, the constant B should read 6B = 0·65 instead of B = 0·65, and the following experiments repeated on the micro-balance gave $COOH/COOH + 2H_2O \rightarrow 6 \cdot 3\ k$ cal.; $Na_2S_2O_3 + 5H_2O \rightarrow 14 \cdot 5\ k$ cal. H. H. Ho.

2012. Homogeneous Combination of Hydrogen and Oxygen. H. W. Thompson and C. N. Hinshelwood. *Roy. Soc., Proc.* 122. *pp.* 610–621, *Feb.* 4, 1929.

It has already been shown in a previous investigation that the homogeneous reaction between hydrogen and oxygen in the region of 500°–600° C. is a chain reaction, the speed of which increased rapidly with the temperature. The chains become " non-stationary " at lower pressures, and the reaction becomes explosive between certain definite upper and lower critical pressures. The theory is advanced that at low concentrations the initiation of the explosion is connected with the producton of hydrogen peroxide. Molecules of the peroxide in small concentrations set up chains, at high concentrations they exert a mutually destructive effect analogous to " antiknock " action. The theory is applied to explain the remarkable effect of nitrogen peroxide on the combination of hydrogen and oxygen.

F. J. B.

2013. Photolysis of Silver Bromide free from Binding Material. Estimation of Bromine. E. Mutter. *Zeits. f. Wiss. Phot.* 26. *pp.* 193–234, *Jan.*, 1929.

The photolysis of AgBr in the presence of water was both qualitatively and quantitatively confirmed, and the bromine which was formed by the photolysis existed in the ionic state at the end conditions. A suitable modification of Volhard's method for the estimation of halogens was used for determining the bromine liberated. Treatment with nitric acid dissolved very little of the silver formed by the photolysis. The far-reaching dependence of the sensitivity of silver bromide on the concentration of the solution used for precipitation was confirmed at 80° C. and 20° C. The mechanism of the reactions which take place in silver salts was examined and explained as an increased acceptor action of the OH ions of water. The velocity of the photolysis of the AgBr was followed by the bromine estimation method. F. J. B.

2014. Photolysis of Silver Halide with reference to the Quantum Theory and Photoelectric Effect. H. Kieser. *Zeits. f. Wiss. Phot.* 26. *pp.* 275–287, *Jan.*, 1929.

In the first part of the paper the secondary reaction of the photoelectric effect is theoretically discussed, from a consideration of the calculation of the quantum gain by photolysis of the gelatine-free silver bromide, and also Fajan's new hypothesis. The necessary supposition made is that with photolysis of the silver halide a system is obtained in which, by means of electronic reaction, individual locally-separated halogen atoms are produced. Chemical secondary reactions are also discussed and formulated for the photolysis of pure silver bromide, silver bromide in water, sodium nitrite solution and gelatine. In the second part, a representation of the physical secondary appearances of the photoelectric effect is attempted, in an extension of Fajan's considerations, and it is found that the hypothesis is capable of explaining the photophysical appearances occurring with illumination of the silver halide, such as regression, coagulation, Becquerel effect and photomechanical dispersion. Finally, the use of the hypothesis for the states of the silver halide-gelatine nucleus is discussed. R. C. F.

2015. Formation of Ozone in Electrical Discharge at Pressures below 3 Millimetres. J. K. Hunt. *Am. Chem. Soc., J.* 51. *pp.* 30–38, *Jan.*, 1929.

The ozone was determined by chemical analysis in the experiments now described on the formation of ozone in the glow discharge in a closed tube at pressures from 0·2 to 2·8 mm. In a previous investigation from the same laboratory [see Abstract 249 (1927)] the influence of the electrodes was studied down to 14 mm. and the ratio of electrode area to volume of discharge was made large. In the present research this ratio was made as small as possible to minimise any catalytic influence of the electrodes. An equilibrium concentration of ozone was reached in less than a minute. The yield of ozone increased with increasing pressure but at a decreasing rate, increased with increasing kathode area, and was independent of electrode material except that aluminium gave abnormally high results. The highest yield obtained was 26 gm. per kilowatt-hour, but all yields were low on account of the decomposition of ozone. A calculation on the basis of ionisation potentials indicated that the number of pairs of ions and the number of molecules of ozone produced were both of the same order of magnitude. The predominating mechanism of ozone formation is possibly one involving collision between monatomic oxygen ions and neutral molecules. H. H. Ho.

2016. Oxidations Promoted by Ultra-Sonic Radiation. F. O. Schmitt, C. H. Johnson and A. R. Olson. *Am. Chem. Soc., J.* 51. *pp.* 370–375, *Feb.*, 1929.

The effect of high-frequency sound waves on various oxidation reactions [see Richards and Loomis, Abstract 990 (1928)] has been investigated. Those of the reactions which are accelerated by the ultra-sonic vibrations involve at least one gaseous constituent, the most striking case being the oxidation of hydrogen sulphide, in which case both reactants are gaseous under normal conditions. To ascertain if the oxidation occurs during the process of cavitation, on the assumption that the formation of an interface is essential to the activation of the oxygen molecules, experiments were made with aqueous potassium solutions containing very small amounts of dissolved air, the result showing that iodine is liberated, although no bubbles are discernible. The mere formation of bubbles in the absence of ultra-sonic vibrations appears unable to effect this oxidation. The fact that higher pressures inhibit the reaction completely argues against the hypothesis that individual oxygen molecules in solution can be activated directly by ultra-sonic energy. A possible explanation of the phenomenon is that there exists a critical bubble-size below the limits of visibility which is essential for the activation of the oxygen, and that pressure beyond a certain degree prevents the cavitation of bubbles of such size and consequently inhibits the reaction. T. H. P.

2017. Formation and Decomposition of Gallic Acid, Pyrogallol Carboxylic Acid, Phloroglucinol Carboxylic Acid and their Potassium Salts. O. Widmer. *Zeits. f. phys. Chem.* 140. *Abt. A.* 3–4. *pp.* 161–193, *Feb.*, 1929.

The velocities of decomposition of pyrogallol carboxylic acid (2:3:4-trihydroxybenzoic acid) and of gallic acid by boiling water have been measured, and found to be reactions of the first order. During the thermal decomposition of dry pyrogallol carboxylic and gallic acids the CO_2 pressure was measured as a function of the time when it was established that this decomposition is greatly accelerated by the products of decomposition and by foreign substances. The constants for the reactions:

Pyrogallol + $KHCO_3 \rightleftarrows$ Potassium Pyrogallol carboxylate + H_2O at 80° and 95°, and

Phloroglucinol + $KHCO_3 \rightleftarrows$ Potassium Phloroglucinol carboxylate + H_2O, at 40°, 49° and 60° have been determined and the velocities of formation and of decomposition of the potassium salts measured. In every parallel case the formation proceeds quicker than the decomposition. H. H. Ho.

2018. Relationship between Stationary State and Equilibrium. E. Baur. *Zeits. f. phys. Chem.* 140. *Abt. A.* 3–4. *pp.* 194–198, *Feb.*, 1929.

It is clearly shown that the break in the Δ *v*-curve does not imply a contradiction to the Guldberg relationship $K = f_1/f_2$ between equilibrium and velocity coefficients. H. H. Ho.

2019. Chemical Equilibrium between Solid Salts. C. Tubandt and H. Reinhold. *Zeits. f. phys. Chem.* 140. *Abt. A.* 3–4. *pp.* 291–308, *Feb.*, 1929.

The reaction between the solid sulphides, selenides and tellurides of silver and monovalent copper with the corresponding halogenides produce a true chemical equilibrium. The equilibrium position is obtained by a determination of the diffusion effect according to a simple weighing process. The mass action rule is found to be applicable to the following reactions: $Ag_2S + 2\,Cu\,I \rightleftharpoons Cu_2S + 2\,Ag\,I$ and $Ag_2S + Cu_2Se \rightleftharpoons Cu_2S + Ag_2Se$. The points of difference in the mechanism of these reactions and the usual diffusion processes of solid salts are discussed. J. K.

2020. Photo Expansion of Chlorine. W. H. Martin, A. F. W. Cole and E. E. Lent. *J. Phys. Chem.* 33. *pp.* 148–153, *Jan.*, 1929.

The expansion of chlorine on exposure to light does not disappear, nor is it greatly lessened on careful purification and drying of the gas. Nor has careful baking out of the walls of the insolation bulb before admission of the dried chlorine any effect on the photo-expansion. Experiments reported here and in a previous paper [see Abstract 613 (1928)] show that dried chlorine at atmospheric pressure and at lower pressure shows no abnormal scattering, nor any fluorescence which can be detected visually or photographically. It is commonly assumed in papers on the theory of the photochemical reactions of chlorine that dry chlorine does not expand on insolation, but that it reradiates the absorbed energy. The above experimental results are not in accord with these assumptions. H. H. Ho.

2021. Budde Effect in Bromine. E. Matthews. *Faraday Soc., Trans.* 25. *pp.* 41–43, *Feb.*, 1929.

Experimental results are given which indicate definitely a diminution in the Budde effect in bromine on drying, but during the period of the experiments this effect did not disappear entirely. T. H. P.

2022. Bromine Chloride. S. Barratt and C. P. Stein. *Roy. Soc., Proc.* 122. *pp.* 582–588, *Feb.* 4, 1929.

The earlier work on the subject of the formation of compounds between bromine and chlorine is reviewed. The present investigation results from the observation made by G. M. B. Dobson, of the Clarendon Laboratory, Oxford, who observed a diminution in the colour of bromine when admixed with chlorine when preparing filters for ultra-violet light. The present investigators, in order to determine the amount of bromine chloride formed, make a spectrophotometric study of the absorption spectra of bromine and of bromine chlorine mixtures. Solutions of these mixtures are employed. It is deduced that in equimolecular mixtures about 50 % of the halogens are present as the compound. The formula of the compound formed is suggested to be BrCl, and this agrees with the observation that on mixing chlorine with bromine in the gaseous state the volume change if existent is very small. J. K.

2023. Gas-Solid Equilibria. Part II. Pressure-Concentration Equilibria between Benzene and (a) Ferric Oxide Gel, (b) Silica Gel, under Isothermal Conditions. B. Lambert and A. M. Clark. *Roy. Soc., Proc.* 122. *pp.* 497–512, *Feb.* 4, 1929.

This work extends Part I [see Abstract 1079 (1928)], the pressure-concentration equilibria of the same systems having been investigated under isothermal conditions and with known concentrations of benzene varying from zero up to saturation. The effects, on known weights of the gels, of the isothermal addition and the isothermal withdrawal of known quantities of benzene have been determined, and "ascending" and "descending" pressure-concentration isothermals have been drawn from these direct measurements. The existence of a profound difference between the absorptive processes of these two analogous gels, for benzene, has been fully confirmed. H. H. Ho.

2024. Some Debatable Problems in Physics. O. Lodge. *Faraday Soc., First Spiers Mem. Lecture* (12 *pp.*), *Nov.* 8, 1928.

The various theories relating to the seat of the current which is produced by the contact of two dissimilar metals forming a voltaic pile was discussed. The theories of Kelvin, Helmholtz and Pointing were contrasted, and experiments described which aimed at proving whether the current were derived from the metals themselves or from the air or gas in contact with the metal. The questions of the stability of the atom and the degradation of energy were considered, together with the irreversibility of certain natural processes. The paper forms a masterly review of the state of knowledge on the debatable problems mentioned. F. J. B.

2025. Oxide Cells of Cadmium, Copper, Tin and Lead. C. G. Maier. *Am. Chem. Soc., J.* 51. *pp.* 194–207, *Jan.*, 1929.

Previous work on zinc oxide [see Abstract 830 (1927)] had furnished very satisfactory values of the free energy of formation of the oxide as compared to results by other methods. Enough work has been done to indicate the limitations of the cell measurement method for free-energy determination upon oxide materials, and oxide electrodes of cadmium oxide, cuprous and cupric oxide, stannous and stannic oxide and lead dioxide have been compared to the hydrogen or mercuric oxide electrode in barium hydroxide solutions. Data are recorded for the free energies and calculated heats of formation. H. H. Ho.

2026. Electromotive and Electrokinetic Potentials of Graphite. N. Thon. *Comptes Rendus*, 188. *pp.* 253–254, *Jan.* 14, 1929.

The author continues his researches on the change effected in cataphoretic velocity by various electrolytes using graphite in place of gold [see Abstract 3140 (1928)]. He finds that in this case the negative value

of ζ steadily decreases with the increasing concentration of the electrolyte, which he explains by assuming a steady condensation of cations both on the immovable wall and in the displacement layer. Graphite thus differs from gold, with which it is the anions which thus condense. Platinum, silver, mercury and copper behave like gold. Graphite behaves like crystal violet, both finally effecting an inversion in the sign of ζ. These results are in conformity with Stern's theories [see Abstract 723 (1925)].
C. A. S.

2027. Concentration Cells in Ethyl Alcohol: Sodium and Potassium Iodides. G. F. Isaacs and J. R. Partington. *Faraday Soc., Trans* 25. *pp.* 53–59, *Feb.*, 1929.

In the determination of the e.m.f. of the two cells with solutions in ethyl alcohol:

$$(1)\quad \mathrm{Ag} \mid \mathrm{AgINaI}(c_1) \mid \mathrm{NaI}(c_2)\mathrm{AgI} \mid \mathrm{Ag},$$

and

$$(2)\quad \mathrm{Ag} \mid \mathrm{AgI}k\mathrm{I}(c_1) \mid \mathrm{KI}(c_2)\mathrm{AgI} \mid \mathrm{Ag},$$

over a range of concentration from $0 \cdot 5\,N$ to $0 \cdot 001\,N$, it is found that satisfactory results cannot be obtained with more concentrated or more dilute solutions. The values of the e.m.f. satisfy Nernst's equation in the form: $\mathrm{E} = 2(1 - n_a)\mathrm{RT/F} \,.\, \log_e \lambda_1 c_1/\lambda_2 c_2$, where n_a is the transport number (of the anion), which is found to be constant except at the highest concentrations ($0 \cdot 5\,N$), and λ_1, λ_2 are the conductivities of the two solutions of concentrations c_1 and c_2. This result is in agreement with that obtained by Grant and Partington [see Abstract 1326 (1924)] for the cell, $\mathrm{Ag} \mid \mathrm{AgNO_3}(c_1) \mid \mathrm{AgNO_3}(c_2) \mid \mathrm{Ag}$ in methyl alcohol, for which previously a variable transport number had been found.
T. H. P.

2028. Oxidation-Reduction Potentials. The Ferric-Ferrous Electrode. S. Popoff and A. H. Kunz. *Am. Chem. Soc., J.* 51. *pp.* 382–394, *Feb.*, 1929.

E.m.f. measurements are made of the cell $\mathrm{PtH_2} \mid \mathrm{HCl} \mid \mathrm{HCl} + \mathrm{FeCl_3} + \mathrm{FeCl_2} \mid \mathrm{Pt}$ by means of an apparatus in which the liquid junction potential is kept constant by a flowing junction. In each series the acid concentration is the same throughout the cell, and in all cases the ratio of the concentrations of the ferric and ferrous chlorides is nearly unity. The liquid junction potential is determined by plotting a function of the potential against the concentration of the ferrous chloride and extrapolating to zero concentration when the liquid junction potential disappears. The correction to the normal oxidation-reduction potential for the presence of hydrochloric acid is determined by plotting the values at various acidities against the acid concentration and again extrapolating to zero. The value for the normal oxidation-reduction potential of the ferric-ferrous electrode thus determined is $- 0 \cdot 7477 \pm 0 \cdot 0005$ volt and is in fair agreement with the value calculated from equilibrium measurements by Noyes and Brann. The principle of ionic strength is applied to the calculation of the normal potential employing data obtained in $0 \cdot 05$ molal hydrochloric acid, and the values thus calculated agree with those derived by extrapolation [see Abstract 781 (1920)].
J. N. P.

2029. Electromotive Forces of Uni-Univalent Halides in Concentrated Aqueous Solutions. H. S. Harned. *Am. Chem. Soc., J.* 51. *pp.* 416–427, *Feb.*, 1929.

Measurements at 25° of high accuracy of cells of the type

$$\mathrm{Ag} \mid \mathrm{AgX} \mid \mathrm{MX(m)} \mid \mathrm{M_xHg} \mid \mathrm{MX}(0 \cdot 1) \mid \mathrm{AgX} \mid \mathrm{Ag}$$

containing sodium and potassium chlorides and bromides were made, and similar, but less accurate, measurements with similar cells containing lithium chloride and bromide. The electromotive forces of the halides are discussed, and considerable departure from additivity is observable. The activity coefficients of sodium and potassium chlorides and bromides are calculated from the results of the electromotive force measurements and compared with those calculated by Hückel's equation. The activity coefficients of ten halides are calculated and discussed, and those of potassium chloride derived from the electromotive-force measurements are compared with the results computed from measurements of the vapour pressure. AUTHOR.

2030. Analysis of Nitrates by an Electrolytic Method. M. Rabinowitsch and A. S. Fokin. *Zeits. f. Elektrochem.* 35. *pp.* 18–20, *Jan.*, 1929.

A method of reducing nitrates to ammonia by nascent hydrogen in alkaline solutions is devised. The nascent hydrogen is obtained by means of sodium amalgam. A convenient apparatus for the analysis is described by means of which the sodium amalgam is renewed by electrolysis as the sodium is used up in producing the nascent hydrogen. The apparatus can also be used for the preparation of various substances by reduction. The method was tested on a preparation of potassium nitrate, and the results are compared with those obtained by the Devarda method. F. J. B.

2031. Electrometric Titration of Manganese by the Volhard Method. B. F. Brann and M. H. Clapp. *Am. Chem. Soc., J.* 51. *pp.* 39–41, *Jan.*, 1929.

The chief objection to the use of the Volhard method is the difficulty in recognising the end-point in the presence of the heavy brown precipitate which forms during the titration, but a modification of Foulk and Bawden's "dead stop end-point" method of electrometric titration [see Abstract 259 (1927)] has been described which has proved satisfactory in the Volhard titration of manganese. H. H. Ho.

2032. Effect of Diffusion at a Moving Boundary between Two Solutions of Electrolytes. D. A. MacInnes and I. A. Cowperthwaite. *Nat. Acad. Sci., Proc.* 15. *pp.* 18–21, *Jan.*, 1929.

In the determination of the transference number of silver nitrate by means of the moving boundary the solution forms with lithium nitrate solution, it is found that if the current is temporarily stopped the sharp boundary gradually fades out so that after about a minute no evidence of discontinuity between the two solutions is observable. Restarting of the current is followed by slow reformation of the boundary, even if the interruption lasts for 30 min. The experimental data show, moreover, that the diffuse zone between the two solutions moves during the interruption of the current at the same rate as the fully formed boundary. Evidently a powerful mechanism exists which tends to restore a boundary to its original condition if diffusion takes place. An explanation of the action of such mechanism is furnished. T. H. P.

2033. Diffusion and Membrane Potentials. A Comparison of Anion and Cation Effects. E. B. R. Prideaux. *Faraday Soc., Trans.* 25. *pp.* 20–23, *Jan.*, 1929.

Previous work by the author has shown that definite and reproducible potentials were set up at a parchment-paper membrane which separated various concentrations of the alkali salts of some organic acids [Abstract 1427 (1928)]. The work was continued and extended to electrolytes of different types over a range of concentration of *n*/10 to *n*/100. Acetic acid and piperidine were used as being weak electrolytes, which yielded measurable amounts of hydrogen and hydroxyl ions, and to give salts which hydrolyse so little as to have no effect on the diffusion potentials. The potentials were measured against the KCl–calomel half cell. It was found that the membrane increased the diffusion potential of a salt with a relatively slow anion, and hence retarded the anion more than the cation. F. J. B.

2034. Electrolytic Solution Forces and the Electrolytic Ionic State. Part IV. Energy of Solution and Solvation, Calculation and Comparison. K. Fredenhagen. *Zeits. f. phys. Chem.* 140. *Abt. A.* 1–2. *pp.* 65–77, *Jan.*, 1929.

The electrolytic solution energy for gas atom→solution ion and the energy of solvation for gas ion→solution ion are defined. The values for these are calculated for a number of elements and the values are compared. The assumption that solution ions are solvated gas ions is so far without proof. The author shows that the substantiation of such an assumption is opposed by many considerations. F. J. B.

2035. Electrodeposition of Silver, with Special Reference to the Use of Sodium Cyanide. E. B. Sanigar. *Faraday Soc., Trans.* 25. *pp.* 1–11; *Disc.*, 11–13, *Jan.*, 1929.

A silver-plating solution of the composition silver nitrate, 35·0 gm./litre, sodium cyanide, 40·4 gm./litre = 100 % excess cyanide, sodium carbonate, 80·0 gm./litre, having an adequate conductivity ($9\cdot08 \times 10^{-2}$ mhos. at 25° C.), was tested and gave good, satiny deposits when worked at current densities of 0·302 ampere/sq. dm. and upwards. Increasing carbonate content causes a softening in the silver deposited. Increasing free cyanide content up to 200 % excess makes a silver deposit softer, after which value the type of deposit changes and also becomes harder. The amount of free cyanide present largely determined the hardness of the deposit. Variation of current density has relatively little influence on the hardness of silver deposits, high values favouring soft deposits. Good deposits can be obtained using higher current densities provided that suitable solution composition and agitation are used. With pure salts good silver deposits can be obtained from solutions containing both sodium and potassium cyanides. However, with old solutions particularly, the two cyanides should not be used together indiscriminately, since troubles apparently arise from the use of impure salts. J. N. P.

2036. Electrolytic Oxidation of Methyl Alcohol in Alkaline Solution. S. Tanaka. *Zeits. f. Elektrochem.* 35. *pp.* 38–42, *Jan.*, 1929.

Results are given of an investigation of the relation of the anode potential to the current density when methyl alcohol, mixed with an equal volume of 8 *N*-sodium hydroxide, is subjected to electrolytic oxidation. The anodes employed consisted of smooth and spongy platinum, rhodium, palladium and silver, and smooth gold. For the smooth anodes the current-density-potential curves are all similar, and, except for palladium, show no sudden change in direction. The curves obtained with the spongy metals are of quite different form, the low potential region being marked by a considerable rise in the current, this being succeeded by a sharp fall and, in the high-potential region, by another rise. As the temperature is increased the initial rise, which in no case is accompanied by evolution of gas, becomes steeper and reaches higher values. No formaldehyde is detectable in the resulting liquid, and it appears that, in the low-potential region, the alcohol is oxidised directly to formic acid in accordance with the equation, $H_3CO' + OH' - 4$ Faradays $= H . CO_2H + 2H$ or $H_3CO' + 3OH' - 4$ Faradays $= H . CO_2H + 2H_2O$. T. H. P.

2037. More Accurate Calculation of Wien's Tension Effect in Electrolytes. M. Blumentritt. *Ann. d. Physik,* 1. 2. *pp.* 195–215, *Jan.* 19, 1929.

Earlier G. Joos and the author have explained [see Abstract 2535 (1928)] that the tension effect in electrolytes discovered by Wien can be deduced from the changeability of the ionic forces of Debye. If the theory of Debye on the conductivity is developed in its simplest form as has been worked out by Debye and Hückel [see Abstract 2541 (1923)], yet the change of the conductivity with the strength of the external field, which is expressed by the higher members of the non-linear of the Debye-Hückel differential equations, is not found to be in agreement with Wien's experimental results in all electrolytes. These differences are to be partially explained by the neglect of the Brownian molecular motions in the Debye-Hückel theory. Their consideration affords a more accurate theory, which Onsager (see Abstract 2642 (1927)] has developed for small external fields. The author in the present paper calculates the relaxation force and the electrophoretic force more accurately with consideration of the Brownian motion, and this removes the remaining discrepancies occurring in Onsager's improvement of the theory, so that for not too high field strengths (up to about 25,000 volts/cm.) the tension effect is now in good agreement with observation. Only for ions of very high valency, for which Onsager's approximation already gives deviations from the observed dependence on concentration, is the frequent agreement with observations not quite attained. J. J. S.

2038. Electrical Behaviour of Surfaces of Corroding Iron. A. L. McAulay and S. H. Bastow. *Chem. Soc., J. pp.* 85–92, *Jan.,* 1929.

When corroding, iron is in a stable and reproducible state, and, provided that the electrodes are first aged by prolonged immersion in an electrolyte and the condition of aeration of the electrolyte is standardised, reproducible results are obtainable. The behaviour of pure electrolytic iron is also typical of that of mild steel and cast iron, difference in composition having little effect provided it does not produce air passivity, as with stainless steel. The latter resembles a noble metal, is easily polarised by minute currents and shows no very definite normal potential. The film responsible for the corrosion current increases in protective power and resistance to destruction as the time of exposure to the air increases up to about two hours, after which little further change occurs. When this stage is reached immersion of the iron in air-free $0 \cdot 5$ N potassium sulphate causes destruction of the ennobling film in about an hour, with consequent return of the metal to the standard state. More drastic oxidation, such as anodic treatment in alkali, produces a film much more resistant to the action of electrolyte, which, however, ultimately causes reversion to the same standard state. The passage of corrosion currents has no effect on the ennobling film that gives rise to the potential differences which produce them. The potentials are modified temporarily owing to polarisation effects, but these effects disappear rapidly when the current is stopped, leaving the film unchanged except for the action of the electrolyte.

T. H. P.

2039. Mechanism of Corrosion. U. R. Evans. *Chem. Soc., J. pp.* 111–129, 1929.

The corrosion of half-immersed specimens of zinc, aluminium, iron, steel and copper commences at certain weak points, mainly along the bottom and cut edges, but frequently in the centre also; when the rate of corrosion is very slow it may occur along the water-line. In zinc, iron and steel in chloride or sulphate solutions the attack spreads out from these points very rapidly, the greater part of the immersed area being finally attacked. The insoluble corrosion product is of four different types, which appear according to the manner in which the anodic and kathodic products come together; in copper and aluminium one of these types is usually absent, but otherwise there is general correlation between the results with zinc, iron and steel. Quantitative experiments show that under conditions of differential aeration, electrolytic iron is attacked nearly as rapidly as steel, and potassium sulphate and potassium chloride cause similar rates of corrosion, notwithstanding that the shapes of the corroded areas are quite different; magnesium sulphate causes much slower attack. Zinc is attacked more quickly than iron, and aluminium much more slowly. Oxygen produces quicker attack on steel than air, but it is restricted to a smaller portion of the specimens; doubling the breadth of half-immersed specimens nearly doubles the rate of attack, but increase of the length of the immersed area has much less effect. These results are understandable if it is remembered that the corrosion current flowing between the kathodic and anodic areas will depend on the e.m.f. of the cell metal/oxygen greatly reduced by polarisation. With aluminium, where the film repairs itself readily and the anodic areas remain small, the anodic polarisation will be most important, but with zinc, iron and steel the kathodic polarisation, which depends on the supply of oxygen, will determine the rate of attack. Iron is corroded less quickly by magnesium sulphate than by potassium sulphate, since the kathodic product, magnesium hydroxide, interferes with the access of oxygen to the metal; zinc is corroded more quickly than iron, even with the same facilities of oxygen supply, because here the value of the unpolarised e.m.f. is higher.

T. H. P.

2040. Passivity of Metals. Part II. Breakdown of the Protective Film and Origin of Corrosion Currents. U. R. Evans. *Chem. Soc., J. pp.* 92–110, *Jan.*, 1929.

Breakdown of the protective film on iron, steel, zinc or aluminium tends to occur where the surface has been bent or cut, or where rolling or casting defects occur at the surface. At such points local corrosion sets in, and usually spreads out, although when dissolved oxygen is in excess the weak point often heals again and the corrosion does not develop. Pre-existing cavities may determine the sites of corrosion, as in zinc, their interiors being inaccessible to repairing oxygen, but this cannot be a common cause of localised attack, which may be obtained under anaerobic conditions if an external e.m.f. be applied. Internal stresses are important in determining corrosion if they are such as to keep the film in a state of weakness.

Differential aeration currents are due to the differences of potential existing between the places where the film is kept in repair by the presence of oxygen and those where it is not kept in repair. Values up to 0·5 volt have been obtained for the e.m.f. due to this cause, but the e.m.f. falls off when a current actually flows. The extension of the breakdown, or the repair of the film, may be followed by changes in potential.

T. H. P.

2041. Passivity Theories. W. J. Müller. *Zeits. f. Elektrochem.* 35. *pp.* 93–94, *Feb.*, 1929.

The view put forward by Hinnüber that anodic passivity arises from dissolved oxygen in the electrolyte which diffuses to the anode is considered to conflict with further experiments, in which it is shown that the presence of oxygen in the electrolyte has no influence on the current density-anodic potential relation, but only affects the kathodic potential through its depolarising action. The different theories of anodic polarisation are summarised, and the evidence is again reviewed which supports the view that the phenomenon is due in the first place to the formation of an oxide or salt layer according to the electrolyte which increases the effective current density at the anode, and this is followed by chemical passivity when a change of valency of the metal occurs, or a displacement of its electronic configuration when the metal dissolves with a different valency or becomes unattackable.

J. N. P.

2042. Electrolysis of Nickel. B. Bogitch. *Comptes Rendus*, 188. *pp.* 328–329, *Jan.* 21, 1929.

To obtain deposits of Ni with not more than 0·1 % of impurities the author divided the electrolytic cell into two parts, anodic and kathodic. The kathodic part contains $NiCl_2$ solution, with a density of 1·2 and a temperature above 65° C. The Ni is deposited, and the impurities in solution are precipitated by addition of $Ni(OH)_3$. The Fe, As and most Co are thus removed, and the solution is then replaced.

R. S. R.

2043. Removal of Carbon Dioxide from the Air by Electrolytic Transport. E. Müller, H. Markert and F. Heinrich. *Zeits. f. Elektrochem.* 35. *pp.* 3–13, *Jan.*, 1929.

A method for the removal of carbon dioxide from the air is developed. The carbon dioxide is absorbed by solutions of caustic alkalies, and the resulting carbonate liquors are then regenerated electrolytically, and again used for the absorption. The possibility of applying the method to the absorption of carbon dioxide in large-scale technical operations is discussed, and the size of the plant necessary for the purpose is calculated.

F. J. B.

2044. Electrolytic Preparation of Hydroxylamine. J. G. Stscherbakow and D. M. Libina. *Zeits. f. Elektrochem.* 35. *pp.* 70–83, *Feb.*, 1929.

In the electrolytic reduction of nitric acid in the presence of sulphuric acid with a mercury kathode, in addition to hydroxylamine, a compound is produced whose properties correspond to the formula $(H_2N . OSO_3 . H)_2 H_2SO_4$, or the sulphuric acid salt of isomono hydroxylamine sulphonic acid. This compound, which is formed only in the presence of hydroxylamine and with low concentrations of nitric acid, separates iodine from potassium iodide and is oxidised to nitric acid by titration with permanganate in the cold. The combined sulphuric acid can be estimated by titration with alkali, using phenol-phthalein as indicator. The compound is hydrolysed to hydroxylamine on warming the electrolyte. The current yield of hydroxylamine increases with increase of concentration of sulphuric and nitric acid in the electrolyte up to a certain limit. With a concentration of sulphuric acid greater than 15—16 *N* the oxidation and solution of the mercury kathode by nitric acid becomes marked. With an increase of nitric acid higher than 1—*N* the formation of oxide of nitrogen increases on electrolysis. The most favourable conditions for the production of hydroxylamine are 5–15 *N* sulphuric acid and 1—*N* nitric acid with a kathodic current density of 0·25 ampere/cm.^{2}, and a temperature of 13° to 16° C. A mean current efficiency of 60–70 % is obtained, and a concentration of hydroxylamine of about 1·5 mol. per litre. In presence of certain impurities which form a visible film on the kathode, which acts as a diaphragm, the reduction of nitric acid falls, and free hydrogen may be liberated quantitatively, while smaller amounts of these impurities, by forming a diaphragm, increase the formation of the iso-compound. At the end of the electrolysis the remaining free nitric acid may be eliminated by continuing the electrolysis with a copper kathode when reduction to ammonia occurs. J. N. P.

2045. Electrolytic Separation of Chromium from Aqueous Chromic Acid Solutions. E. Müller and P. Ekwall. *Zeits. f. Elektrochem.* 35. *pp.* 84–89, *Feb.*, 1929.

In the electrolysis of a pure chromic acid solution with a carbon kathode a film of chromic chromate begins to form at a potential, measured against a normal calomel electrode, of + 0·8 volt, while evolution of hydrogen begins at about — 1·2 volt. With a platinum electrode, hydrogen evolution begins at about 0·4 volt, while the separation of chromium, which is contaminated with oxide, occurs at about — 1·2 volt, and is preceded by the formation of the insoluble chromic chromate film, which is first observed microscopically at — 0·7 volt, and is pressed cataphoretically to the kathode. An investigation is made of the properties of this film, which is prepared as a colloid by the action of alcohol on pure chromic acid. The gel is purified by dialysis, and is found to migrate to the kathode, where it is coagulated. The compound is soluble in acids and bases, and its composition corresponds to the formula $Cr_2(OH)_4CrO_4$. When present as a film, the molecules are oriented and form a diaphragm, which is impervious to CrO_4'' or $HCrO_4'$ ions, but allows $H^{\cdot}$ ions to pass. Reaction accordingly ceases until the hydrogen separation potential is exceeded when the film is broken and the reaction follows in accordance with the equation: $Cr_2(OH)_4CrO_4 + 2H_2CrO_4^{\cdot} = 2Cr^{\cdot\cdot\cdot} + 3CrO_4'' + 4H_2O$. Deposition of chromium then occurs, and the chromic chromate film is again formed. The deposition of sucessive layers of this film according to the magnitude of the applied potential is shown under the microscope by difference in colour. The presence of sulphuric acid in the electrolyte modifies the film formation and increases the intervals of exposure of the electrode, whereby greater accession of chromium ions results, while contamination of the deposited metal with oxide is suppressed. J. N. P.